AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR

&

VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

(Constituent Colleges of Vinayaka Mission's Research Foundation Deemed to be University)

AICTE APPROVED & NAAC Accredited

VINAYAKA MISSION'S RESEARCH FOUNDATION

(Deemed to be University under section 3 of the UGC Act 1956)

Faculty of Engineering and Technology

Department of Mechanical Engineering

Programme : B.E – Mechanical Engineering

Choice Based Credit System (CBCS)

Curriculum & Syllabus (Semester I to VIII)

Regulations 2021

AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY, PAIYANOOR
&
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING COLLEGE, SALEM

Department of Mechanical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO.1	Design, analyze & fabricate, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable to enhance quality of life.
PEO.2	Apply modern computational, analytical, simulation tools and techniques to address the challenges faced in mechanical and allied engineering streams.
PEO.3	Communicate effectively using innovative tools and demonstrate leadership & entrepreneurial skills.
PEO.4	Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career and organizational goals.

PROGRAM SPECIFIC OUTCOMES (PSOs)

To achieve the mission of the program, Mechanical Engineering graduates will be able:

PSO.1	To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyze, synthesize technical data for application to product, process, system design & development
PSO.2	To understand & contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement
PSO.3	To develop expertise towards use of modern engineering tools, careers in industries and research and demonstrate entrepreneurial skill

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF MECHANICAL ENGINEERING

Credit Requirement for Course Categories

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM – REGULAR STUDENTS

Sl. No.	Category of Courses	Types of Courses		Suggested Breakup of Credits (min – max)
1.	**A. Foundation Courses**	Humanities and Social Sciences including Management courses		9-12
2.		Basic Science courses		18 – 25
3.		Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.		18 – 24
4.	**B. Professional**	Core courses		48-54
5.	**C. Elective Courses**	Professional Electives		12
		Industry Designed/ Industry Supported/ Industry Offered/ Industry Sponsored courses		6
		Open Electives	Innovation, Entrepreneurship, Skill Development etc.	6-9
			Emerging Areas like 3D Printing, Artificial Intelligence, Internet of Things etc.	6-9
6.	**D. Courses for Presentation of technical Skills related to the specialization**	Project work		8
		Mini Project		3
		Seminar		1
		Internship		3
7.	****E. Mandatory Courses**	Yoga and Meditation, Indian Constitution, Essence of Indian Traditional Knowledge, NCC/NSS/RRC/YRC/Student Clubs/ Unnat Bharat Abhiyan/Swachh Bharat, Sports and Games, Gender Equity and Law		Zero Credit Course (Minimum 2 Courses to be completed other than Yoga and Meditation)
			Minimum Credits to be earned	160

**** The credits earned in category 'E' Courses will not be counted in CGPA calculation for awarding of the degree.**

B.E./B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII

A.Foundation Courses

Humanities and Social Sciences including Management Courses –Credits (9-12)

SL. NO	COURSE CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	34121H01	TECHNICAL ENGLISH	ENG	FC-HS	3	0	0	3	NIL
2	34121H81	ENGLISH LANGUAGE LAB	ENG	FC-HS	0	0	4	2	NIL
3	34121H04	BUSINESS ENGLISH	ENG	FC-HS	3	0	0	3	NIL
4	34121H02	TOTAL QUALITY MANAGEMENT	MANAG	FC-HS	3	0	0	3	NIL
5	34121H05	ENGINEERING MANAGEMENT AND ETHICS	MANAG	FC-HS	3	0	0	3	NIL
6	34121H83	UNIVERSAL HUMAN VALUES-UNDERSTANDING HARMONY	ENG	FC-HS	3	0	0	3	NIL
7	34121H08	OPERATIONS MANAGEMENT	MANAG	FC-HS	3	0	0	3	NIL
8	34121H11	SOFT SKILLS FOR ENGINEERS	ENG	FC-HS	3	0	0	3	NIL

Basic Science Courses –Credits (18-25)

1	34121B01	ENGINEERING MATHEMATICS	MATH	FC-BS	2	1	0	3	NIL
2	34121B04	PHYSICAL SCIENCES	PHY &CHEM	FC-BS	4	0	0	4	NIL
3	34121B12	SMART MATERIALS	PHY	FC-BS	3	0	0	3	NIL
4	34121B81	PHYSICAL SCIENCES LAB	PHY &CHEM	FC-BS	0	0	4	2	NIL
5	34121B24	INDUSTRIAL MATERIALS	CHEM	FC-BS	3	0	0	3	NIL
6	34121B11	MATHEMATICS FOR MECHANICAL SCIENCES	MATH	FC-BS	2	1	0	3	ENGINEERING MATHEMATICS
7	34121B15	NUMERICAL METHODS FOR MECHANICAL SCIENCES	MATH	FC-BS	2	1	0	3	1.ENGINEERING MATHEMATICS 2.MATHEMATICSFOR MECHANICAL SCIENCES
8	34121B35	RESOURCE MANAGEMENT TECHNIQUES	MATH	FC-BS	2	1	0	3	NIL
9	34121B18	PROBABILITY AND STATISTICS	MATH	FC-BS	2	1	0	3	NIL
10	34121B19	ENVIRONMENTAL SCIENCES	CHEM	FC-BS	3	0	0	3	NIL

Engineering Science courses including Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc-Credits (18-24)									
1	35021E01	FOUNDATIONS OF COMPUTING AND PROGRAMMING (THEORY AND PRACTICALS)	CSE	FC-ES	2	0	2	3	NIL
2	34421E01	BASICS OF CIVIL AND MECHANICAL ENGINEERING	CIVIL & MECH	FC-ES	4	0	0	4	NIL
3	35021E02	PYTHON PROGRAMMING (THEORY AND PRACTICALS)	CSE	FC-ES	2	0	2	3	NIL
4	34621E01	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	EEE &ECE	FC-ES	4	0	0	4	NIL
5	34421E83	WORKSHOP PRACTICES	MECH	FC-ES	0	0	4	2	NIL
6	35021E03	PROGRAMMING FOR PROBLEM SOLVING	CSE	FC-ES	3	0	0	3	NIL
7	34621E81	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LAB	EEE &ECE	FC-ES	0	0	4	2	NIL
8	34421E81	ENGINEERING GRAPHICS AND DESIGN	MECH	FC-ES	0	0	6	3	NIL
9	34421E02	ENGINEERING MECHANICS	MECH	FC-ES	2	1	0	3	NIL

B.E./B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII									
B.Professional Courses									
Core Courses – Credits (48-54)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421C02	MANUFACTURING PROCESSES (THEORY AND PRACTICALS)	MECH	CC	3	0	2	4	NIL
2	34421C05	FLUID MECHANICS AND MACHINERY(THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	NIL
3	34421C08	MECHANICS OF MACHINES (THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	NIL
4	34421C03	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY (THEORY AND PRACTICALS)	MECH	CC	3	0	2	4	NIL
5	34421C06	STRENGTH OF MATERIALS (THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	NIL
6	34421C04	ENGINEERING THERMODYNAMICS(THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	NIL
7	34421C09	THERMAL ENGINEERING (THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	ENGINEERING THERMODYNAMICS
8	34421C11	DESIGN OF MACHINE ELEMENTS	MECH	CC	2	1	0	3	NIL
9	34421C13	ENGINEERING METROLOGY AND MEASUREMENTS (THEORY AND PRACTICALS)	MECH	CC	3	0	2	4	NIL
10	34421C10	AUTOMOBILE ENGINEERING (THEORY AND PRACTICALS)	MECH	CC	3	0	2	4	NIL
11	34421C07	COMPUTER INTEGRATED MANUFACTURING (THEORY AND PRACTICALS)	MECH	CC	3	0	2	4	NIL
12	34421C12	DESIGN OF TRANSMISSION SYSTEMS	MECH	CC	2	1	0	3	DESIGN OF MACHINE ELEMENTS
13	34421C16	HEAT AND MASS TRANSFER (THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	THERMAL ENGINEERING
14	34421C14	FINITE ELEMENT ANALYSIS (THEORY AND PRACTICALS)	MECH	CC	2	1	2	4	NIL

B.E./B.TECH. – MECHANICAL ENGINEERING - SEMESTER I TO VIII

C.Elective Courses

Professional Electives Credits-(12)

SL. NO	COURSE CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1	34421P01	RENEWABLE SOURCES OF ENERGY	MECH	EC-PS	3	0	0	3	NIL
2	34421P03	ADVANCED IC ENGINES	MECH	EC-PS	3	0	0	3	NIL
3	34421P15	INDUSTRIAL TRIBOLOGY	MECH	EC-PS	3	0	0	3	NIL
4	34421P16	LEAN MANUAFCTURING SYSTEMS	MECH	EC-PS	3	0	0	3	NIL
5	34421P13	INDUSTRIAL ENGINEERING	MECH	EC-PS	3	0	0	3	NIL
6	34421P12	HYDRAULICS AND PNEUMATICS SYSTEMS	MECH	EC-PS	3	0	0	3	NIL
7	34421P09	FAILURE ANALAYSIS OF MATERIALS	MECH	EC-PS	3	0	0	3	NIL
8	34421P11	FUNDAMENTALS OF PIPING ENGINEERING	MECH	EC-PS	3	0	0	3	NIL
9	34421P04	CONCURRENT ENGINEERING	MECH	EC-PS	3	0	0	3	NIL
10	34421P08	ENGINEERING PRODUCT DESIGN	MECH	EC-PS	3	0	0	3	NIL
11	34421P07	DESIGN OF EXPERIMENTS	MECH	EC-PS	3	0	0	3	NIL
12	34421P10	FLUID POWER SYSTEMS	MECH	EC-PS	3	0	0	3	NIL
13	34421P17	MEMS AND NEMS	MECH	EC-PS	3	0	0	3	NIL
14	34421P19	PETROLEUM PRODUCTION ENGINEERING	MECH	EC-PS	3	0	0	3	NIL

Industry Designed/ Industry Supported/ Industry Offered/ Industry Sponsored courses – Credits-(6)

SL. NO	COURSE CODE	COURSE	OFFERING INDUSTRY	CATEGORY	L	T	P	C	PREREQUISITE
1	34421I01	INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	INFOSYS	EC-IE	3	0	0	3	NIL
2	34121I11	DESIGN OF AIRCRAFT STRUCTURES	INFOSYS	EC-IE	3	0	0	3	NIL
3	34421I03	BASIC COMPONENT MODELING	MATHWORKS	EC-IE	3	0	0	3	NIL
4	34121I29	VEHICLE DYNAMICS	MATHWORKS	EC-IE	3	0	0	3	NIL
5	34121I19	MATLAB FOR MECHANICAL ENGINEERS	MATHWORKS	EC-IE	3	0	0	3	NIL
6	34121I21	NEW PRODUCT DEVELOPMENT	KRIATEC	EC-IE	3	0	0	3	NIL
7	34121I24	QUALITY CONTROL – TOOLS AND PROBLEM SOLVING METHODOLOGIES	KRIATEC	EC-IE	3	0	0	3	NIL
8	34121I26	SOFT SKILLS	INFOSYS	EC-IE	3	0	0	3	NIL

Open Electives – Electives from Innovation, Entrepreneurship, Skill Development etc. Credits –(6-9)									
1	34121O01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	MANAG	OE-IE	3	0	0	3	NIL
2	34121O02	INTELLECTUAL PROPERTY RIGHTS	MANAG	OE-IE	3	0	0	3	NIL
3	34121O04	INNOVATION, PRODUCT DEVELOPMENT AND COMMERCIALIZATION	MANAG	OE-IE	3	0	0	3	NIL
4	34121O07	SOCIAL ENTREPRENEURSHIP	MANAG	OE-IE	3	0	0	3	NIL
5	34121O06	NEW VENTURE PLANNING AND MANAGEMENT	MANAG	OE-IE	3	0	0	3	NIL
6	34121O03	FINANCE AND ACCOUNTING FOR ENGINEERS	MANAG	OE-IE	3	0	0	3	NIL
Open Electives – Electives from other Emerging Areas Credits-(6-9)									
1	35321O01	BIOSENSORS AND TRANSDUCERS	BME	OE-EA	3	0	0	3	NIL
2	35321O03	PRINCIPLES OF BIOMEDICAL INSTRUMENTATION	BME	OE-EA	3	0	0	3	NIL
3	38121O02	INTRODUCTION TO BIOFUELS	BTE	OE-EA	3	0	0	3	NIL
4	38121O01	FOOD AND NUTRITION TECHNOLOGY	BTE	OE-EA	3	0	0	3	NIL
5	34221O01	DISASTER RISK MANAGEMENT	CIVIL	OE-EA	3	0	0	3	NIL
6	34221O02	MUNICIPAL SOLID WASTE MANAGEMENT	CIVIL	OE-EA	3	0	0	3	NIL
7	35021O02	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	CSE	OE-EA	3	0	0	3	NIL
8	35021O03	INTRODUCTION TO INTERNET OF THINGS	CSE	OE-EA	3	0	0	3	NIL
9	35021O01	CYBER SECURITY	CSE	OE-EA	3	0	0	3	NIL
10	34721O01	DESIGN OF ELECRONIC EQUIPMENT	ECE	OE-EA	3	0	0	3	NIL
11	34721O02	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	ECE	OE-EA	3	0	0	3	NIL
12	34621O01	GREEN POWER GENERATION SYSTEMS	EEE	OE-EA	3	0	0	3	NIL
13	34621O02	INDUSTRIAL DRIVES AND AUTOMATION	EEE	OE-EA	3	0	0	3	NIL
14	36921O01	BIOMOLECULES-STRUCTURE AND FUNCTION	PE	OE-EA	3	0	0	3	NIL
15	36921O02	PHARMACOGENOMICS	PE	OE-EA	3	0	0	3	NIL

B.E./B.TECH. – MECHANICAL ENGINEERING – SEMESTER I TO VIII									
D. Courses for Presentation of technical Skills related to the specialization									
Project Work, Seminar and Internship in Industry or elsewhere Credits-(15)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421R01	PROJECT WORK	MECH	PI-P	0	0	16	8	NIL
2	34421M81	MINI PROJECT	MECH	PI-M	0	0	6	3	NIL
3	34421T81	INTERNSHIP	MECH	PI-I	3 WEEKS			3	NIL
4	34421S81	SEMINAR	MECH	PI-S	0	0	2	1	NIL

B.E./B.TECH. –MECHANICAL ENGINEERING – SEMESTER I TO VIII									
E. Mandatory Courses									
MANDATORY COURSES (ZERO CREDITS) (NOT INCLUDED FOR CGPA CALCULATIONS)									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34121Z81	YOGA AND MEDITATION	PHED	AC	0	0	2	0	NIL
ANY TWO COURSES									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34121Z84	INDIAN CONSTITUTION	LAW	AC	0	0	2	0	NIL
2	34121Z83	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	GEN	AC	0	0	2	0	NIL
3	34121Z85	NCC/NSS/RRC/YRC/STUDENT CLUBS/UNNAT BHARAT ABHIYAN/ SWACTH BHARAT/ROTTARACT CLUB	GEN	AC	0	0	2	0	NIL
4	34121Z86	SPORTS AND GAMES	PHED	AC	0	0	2	0	
5	34121Z82	GENDER EQUITY AND LAW	LAW	AC	0	0	2	0	NIL

SPECIALIZATION – 3D PRINTING AND DESIGN									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	344213D01	CAD FOR ADDITIVE MANUFACTURING	MECH	EC-SE	3	0	0	3	NIL
2	344213D02	POWDER METALLURGY	MECH	EC-SE	3	0	0	3	NIL
3	344213D03	ADDITIVE MANUFACTURING IN MEDICAL APPLICATIONS	MECH	EC-SE	3	0	0	3	NIL
4	344213D04	RAPID TOOLING AND INDUSTRIAL APPLICATIONS	MECH	EC-SE	3	0	0	3	NIL
5	344213D05	POLYMER ENGINEERING	MECH	EC-SE	3	0	0	3	NIL
6	344213D06	3D PRINTING AND DESIGN	MECH	EC-SE	3	0	0	3	NIL
7	344213D07	ADVANCED 3D PRINTING LAB	MECH	EC-SE	0	0	4	2	NIL
8	344213D08	ADDITIVE MANUFACTURING MACHINES AND SYSTEMS	MECH	EC-SE	3	0	0	3	NIL
9	344213D09	PROTOTYPING METHODS	MECH	EC-SE	3	0	0	3	NIL
10	344213D10	THEORY OF 3D PRINTING	MECH	EC-SE	3	0	0	3	NIL
SPECIALIZATION –AUTOMATED DESIGN AND MANUFACTURING ENGINEERING									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421AD01	ADDITIVE MANUFACTURING PROCESSES AND APPLICATIONS	MECH	EC-SE	3	0	0	3	NIL
2	34421AD02	MECHANICAL DESIGN	MECH	EC-SE	3	0	0	3	NIL
3	34421AD03	INTEGRATED PRODUCT DESIGN AND DEVELOPMENT	MECH	EC-SE	3	0	0	3	NIL
4	34421AD04	MANUFACTURING CONTROL AND AUTOMATION	MECH	EC-SE	3	0	0	3	NIL
5	34421AD05	ADVANCED MACHINING PROCESSES	MECH	EC-SE	3	0	0	3	NIL
6	34421AD06	ROBOTICS BASED INDUSTRIAL AUTOMATION	MECH	EC-SE	3	0	0	3	NIL
7	34421AD07	AUTOMATION IN MANUFACTURING	MECH	EC-SE	3	0	0	3	NIL
8	34421AD08	ADVANCED CIM LAB	MECH	EC-SE	0	0	4	2	NIL
9	34421AD09	PRODUCT DESIGN FOR MANUFACTURINGAND ASSEMBLY	MECH	EC-SE	3	0	0	3	NIL
10	34421AD10	REVERSE ENGINEERING AND COMPUTER AIDED INSPECTION	MECH	EC-SE	3	0	0	3	NIL
11	34421AD11	AUTOMATION LAB	MECH	EC-SE	0	0	4	2	NIL
SPECIALIZATION –AUTOMOBILE ENGINEERING									
SL. NO	**COURSE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**

	CODE								
1	34421AU01	AUTOMOTIVE CHASSIS LAB	MECH	EC-SE	0	0	4	2	NIL
2	34421AU02	AUTOMOTIVE CHASSIS	MECH	EC-SE	3	0	0	3	NIL
3	34421AU03	AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB	MECH	EC-SE	0	0	4	2	NIL
4	34421AU04	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	MECH	EC-SE	3	0	0	3	NIL
5	34421AU05	AUTOMOTIVE POLLUTION CONTROL	MECH	EC-SE	3	0	0	3	NIL
6	34421AU06	ENGINE AND VEHICLE MANAGEMENT SYSTEM	MECH	EC-SE	3	0	0	3	NIL
7	34421AU07	SPECIAL TYPES OF VEHICLES	MECH	EC-SE	3	0	0	3	NIL
8	34421AU08	TWO AND THREE WHEELER LAB	MECH	EC-SE	0	0	4	2	NIL
9	34421AU09	TWO AND THREE WHEELER TECHNOLOGY	MECH	EC-SE	3	0	0	3	NIL
10	34421AU10	VEHICLE MAINTENANCE AND SERVICING LAB	MECH	EC-SE	0	0	4	2	NIL
11	34421AU11	VEHICLE MAINTENANCE	MECH	EC-SE	3	0	0	3	NIL
12	34421AU12	VEHICLE TRANSPORT MANAGEMENT	MECH	EC-SE	3	0	0	3	NIL
13	34421AU13	INTRODUCTION TO ELECTRIC MOBILITY	MECH	EC-SE	3	0	0	3	NIL
SPECIALIZATION – ENERGY ENGINEERING									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421EE01	ALTERNATE FUEL TESTING LAB	MECH	EC-SE	0	0	4	2	NIL
2	34421EE02	BIO ENERGY TECHNOLOGY	MECH	EC-SE	3	0	0	3	NIL
3	34421EE03	ENERGY CONSERVATION IN THERMAL SYSTEMS	MECH	EC-SE	3	0	0	3	NIL
4	34421EE04	ENERGY LAB	MECH	EC-SE	0	0	4	2	NIL
5	34421EE05	ENERGY STORAGE SYSTEMS	MECH	EC-SE	3	0	0	3	NIL
6	34421EE06	HYDROGEN AND FUEL CELL TECHNOLOGY	MECH	EC-SE	3	0	0	3	NIL
7	34421EE07	WASTE ENERGY CONVERSION TECHNOLOGIES	MECH	EC-SE	3	0	0	3	NIL
8	34421EE08	ENERGY CONSERVATION AND MANAGEMENT	MECH	EC-SE	3	0	0	3	NIL
SPECIALIZATION –THERMAL ENGINEERING									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421TE01	COMBUSTION ENGINEERING	MECH	EC-SE	3	0	0	3	NIL
2	34421TE02	COMPUTATIONAL FLUID DYNAMICS	MECH	EC-SE	3	0	0	3	NIL
3	34421TE03	CRYOGENIC ENGINEERING	MECH	EC-SE	3	0	0	3	NIL

4	34421TE04	DESIGN OF THERMAL POWER EQUIPMENTS	MECH	EC-SE	3	0	0	3	NIL
5	34421TE05	HEAT EXCHANGERS – FUNDAMENTALS AND DESIGN ANALYSIS	MECH	EC-SE	3	0	0	3	NIL
6	34421TE06	POWER PLANT ENGINEERING	MECH	EC-SE	3	0	0	3	NIL
7	34421TE07	REFRIGERATION AND AIR-CONDITIONING	MECH	EC-SE	3	0	0	3	NIL
8	34421TE08	TURBOMACHINERY	MECH	EC-SE	3	0	0	3	NIL
SPECIALIZATION – AERONAUTICAL ENGINEERING									
SL. NO	**COURSE CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1	34421AE01	AIRCRAFT STRUCTURES	MECH	EC-SE	3	0	0	3	NIL
2	34421AE02	AERO ENGINE LAB	MECH	EC-SE	0	0	4	2	NIL
3	34421AE03	AERODYNAMICS LAB	MECH	EC-SE	0	0	4	2	NIL
4	34421AE04	AERODYNAMICS	MECH	EC-SE	3	0	0	3	NIL
5	34421AE05	AEROSPACE PROPULSION LAB	MECH	EC-SE	0	0	4	2	NIL
6	34421AE06	AEROSPACE PROPULSION	MECH	EC-SE	3	0	0	3	NIL
7	34421AE07	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	MECH	EC-SE	3	0	0	3	NIL
8	34421AE08	AIRCRAFT MATERIALS AND PROCESSES	MECH	EC-SE	3	0	0	3	NIL
9	34421AE09	AIRCRAFT PERFORMANCE STABILITY AND CONTROL	MECH	EC-SE	3	0	0	3	NIL
10	34421AE10	AIRCRAFT STRUCTURES LAB	MECH	EC-SE	0	0	4	2	NIL

HUMANITIES AND SOCIAL SCIENCES COURSES

		Category	L	T	P	Credit
34121H01	**TECHNICAL ENGLISH**	**FC-HS**	**3**	**0**	**0**	**3**

Preamble

Technical English is a life skill course necessary for all students of Engineering and Technology. It aims at developing communication skills in English, essential for understanding and expressing the ideas of different professional context. The outcome of the course is to help the students acquire the language skills of Listening, Speaking, Reading and Writing competency in English language and thereby making the students competent and employable in the globalised scenario.

Prerequisite : NIL

Course Objectives

1	To enable students to develop LSRW skills in English. (Listening, Speaking, Reading, and Writing.)
2	To make them become effective communicators.
3	To ensure that learners use Electronic media materials for developing language.
4	To aid the students with employability skills.
5	To develop the students communication skills in formal and informal situations.

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

CO1.	Listen, remember and respond to others in different scenario	Remember
CO2.	Understand and speak fluently and correctly with correct pronunciation in different situation.	Understand
CO3.	To make the students experts in professional writing.	Apply
CO4.	To make the students in proficient technical communicator.	Apply
CO5.	To make the students recognize the role of technical writing in their careers in business, technical and scientific field	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	L	L	M	M	M	-	S	-	S	S	-	S
CO2	-	-	-	-	-	-	L	-	-	S	-	S	M	-	S
CO3	-	-	-	L	-	-	-	L	-	-	-	L	M	M	-
CO4	L	-	-	-	-	M	-	L	M	S	L	S	S	M	S
CO5	M	-	L	S	-	-	-	-	-	-	-	S	M	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO COMMUNICATION

Self introduction –understanding SWOT and SOAR, Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Listening Skills- Passive and Active listening, Listening to Native Speakers - Characteristics of a good listener.

GRAMMAR AND VOCABULARY

Identify the different Parts of Speech- Word formation with prefixes and suffixes -Common Errors in English - Scientific Vocabulary (definition and meaning)– Technical Abbreviations and Acronyms Sentence Pattern (SVOCA) ,Tense forms , Conditional Sentences, Impersonal Passive Voice, Articles - Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines -Listening to Indian speakers from different regions, intrusion of mother tongue - Homophones – Homonyms - Note taking and Note making

SPEAKING SKILLS

Verbal and Non verbal Communication - Describing objects - Process Description- Interpretation of Images

and Films Speaking Practice - Telephone Etiquettes - Telephonic conversation with dialogue- Interpersonal Skills.

READING SKILLS

Reading for information- Technical articles, News Letters and Editing - Skimming- Scanning - How to Improve Reading Speed – Technical Jargons

TECHNICAL WRITING

Types of paragraphs -- Technical and Non technical Report Writing/ Proposal (Attend a technical seminar and submit a report) Transcoding (Flow Chart, Bar Chart and Pie Chart) – Informal and Formal letters – Application letter- Resume Writing- Difference among Bio data, Resume and Curriculum Vitae, Digital resume Techniques, Statement of Purpose (SOP), Proof reading

Text Books

1. English for Engineers- Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

Reference Books

1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and Cambridge University Press.
4. Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

Alternative NPTEL/SWAYAM Course – Nil

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	-	-	-	-

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. Jennifer G Joseph	Professor & Head	English /AVIT	jennifer@avit.ac.in
2	Dr. P.Saradha	Associate Professor	English /VMKVEC	saradhap@vmkvec.edu.in

		Category	L	T	P	Credit
34121H81	ENGLISH LANGUAGE LAB	FC-HS	0	0	4	2

Preamble

English Language Laboratory provides technological support to students. It acts as a platform for learning, practicing and producing language skills through interactive lessons and communicative mode of teaching.

Prerequisite : NIL

Course Objectives

1	To understand communication nuisances in the corporate sector.
2	To understand the role of mother tongue in second language learning and to avoid interference of mother tongue.
3	To improve the oral skills of the students communicate effectively through different activities.
4	To understand and apply the telephone etiquette.
5	Case study to understand the practical aspects of communication.

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

CO1.	Give best performance in group discussion and interview.	Understand
CO2.	Best performance in the art of conversation and public speaking.	Apply
CO3.	Give better job opportunities in corporate companies.	Apply
CO4.	Better understanding of nuances of English language through audio-visual experience and group activities.	Apply
CO5.	Speaking skills with clarity and confidence which in turn enhances their employability skills.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	S	M	S	-	L	-	-	S	S	M	-	-	-	M
CO2	M	-	-	-	-	-	-	-	M	S	-	M	M	-	M
CO3	M	-	-	-	-	-	-	-	-	S	-	M	-	-	M
CO4	M	-	-	-	-	-	-	-	-	M	-	-	M	-	M
CO5	M	-	-	-	-	-	-	-	-	M	-	-	M	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE I

Ice Breaker, Grouping, Listening- (Hearing and listening)- Active Listening- Passive Listening – Listening to songs, videos and understanding- (fill in the blanks) Telephone Conversation.

MODULE II

Influence of mother tongue, videos, understanding nuances of English language (video) puzzle to solve, Activity. Interpreting and Analysing a research article - Approaches to Review Paper Writing - Structure of a research article - Referencing

MODULE III

Why is English important, Communication skills, TED (video) Communication in different scenario – a case study, ingredients of success, Activity – chart, speak the design, feedback on progress, Group wise, Individual. Role Play

MODULE IV

Telephone Etiquette, Dining Etiquette, Meeting Etiquette, Corporate Etiquette, Business Etiquette.				
MODULE V				
Case study of Etiquette in different scenario				
Alternative NPTEL/SWAYAM Course – Nil				
S.No	**NPTEL /SWAYAM Course Name**	**Instructor**	**Host Institution**	**Duration**
	-	-	-	-

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. Jennifer G Joseph	Professor & Head	English /AVIT	jennifer@avit.ac.in
2	Dr. P.Saradha	Associate Professor	English /VMKVEC	saradhap@vmkvec.edu.in

		Category	L	T	P	Credit
34121H04	BUSINESS ENGLISH	FC-HS	3	0	0	3

Preamble

Language is one of the most valued possessions of men. It acts as a repository of wisdom. Among all other languages English, the international language plays a vital role as a propeller for the advancement of knowledge in different fields and as a telescope to view the dream of the future.

Prerequisite : NIL

Course Objectives

1	To impart and enhance corporate communication.
2	To enable learners to develop presentation skills.
3	To build confidence in learners to use English in Business context.
4	To make them experts in professional writing.
5	To equip students with employability and job searching skills.

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

CO1.	Communicate with a range of formal and informal context	Understand
CO2.	Demonstrate interaction skills and consider how own communication is adjusted in different scenario.	Apply
CO3.	Use strengthened oral and written skills in the business context.	Apply
CO4.	Create interest in a topic by exploring thoughts and ideas.	Apply
CO5.	Have better performance in the art of communication	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	L	-	L	S	S	-	M	S	-	S	S	-	-
CO2	-	M	S	M	-	M	M	-	L	S	-	S	M	-	-
CO3	L	M	-	-	-	M	-	L	-	S	L	M	-	M	-
CO4	-	L	M	M	-	-	L	M	M	S	L	M	M	-	M
CO5	-	L	-	M	-	L	L	-	-	S	-	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF LANGUAGE AND LISTENING SKILLS

Subject and Verb Agreement (concord) - Preposition and Relative Pronoun - Cause and effect - Phrasal Verbs-Idioms and phrases-Listening Comprehension -Listening to Audio Files and Answering Questions-Framing Questions-Negotiation Skills-Presentation Skills and Debating Skills

SPEAKING SKILLS

Stress (Word Stress and Sentence Stress) Intonation- Difference between British and American English Vocabulary-Indianism-Compound Words (including Technical Terminology) Jargons- Technical and Business, Listening to TED Talks and discussion on the topic heard

READING SKILLS

Extempore**,** Speaking activities- pair and group designed by the faculty, Group Discussion-Types of Interviews, Watching Documentary Films and Responding to Questions, Reading Skills-Skimming, Scanning, Understanding Ideas and making Inferences-– FAQs –,Critical Reading-Book Review-Finding Key Information and Shifting Facts from Opinions, reading for pleasure (motivational, short novels, classical etc)

CORPORATE COMMUNICATION

What is Corporate Communication? Types of Office communications -Recommendation-Instruction-Check List- Circulars-Inter Office Memo- Minutes of Meeting and Writing Agenda - Discourse Markers , Technical Articles – Written communication Project Proposals- E - Mail Netiquette - Sample E – mails Making Presentations on given Topics -Preparing Power Point Presentations-Business Letters (Calling for Quotation, Placing Orders and Complaint Letters)

Text Books

1. English for Effective Communication - Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

Reference Books

1. Grammar Builder – I, II, III – Cambridge University Press.
2. Technical English – Writing, Reading and Speaking – Pickett and Lester, Harper and Row

Alternative NPTEL/SWAYAM Course – Nil

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	-	-	-	-

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. Jennifer G Joseph	Professor & Head	English /AVIT	jennifer@avit.ac.in
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	TOTAL QUALITY MANAGEMENT	Category	L	T	P	Credit
34121H02		FC-HS	3	0	0	3

PREAMBLE:

Quality is the mantra for success or even for the survival of any organization in this competitive global market. Total Quality Management (TQM) is an enhancement to the traditional way of doing business. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach for providing quality of products and processes. It becomes essential to survive and grow in global markets, organizations will be required to develop customer focus and involve employees to continually improve Quality and keep sustainable growth.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Total Quality Management concepts.
2. To practice the TQM principles.
3. To apply the statistical process control.
4. To analyze the various TQM tools.
5. To adopt the quality systems.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the importance of quality and TQM at managerial level.	Understand
CO2: Practice the relevant quality improvement tools to implement TQM.	Apply
CO3: Analyse various TQM parameters with help of statistical tools.	Analysing
CO4: Assess various TQM Techniques.	Evaluate
CO5: Practice the Quality Management Systems in a different organization Environment.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	-	L	L	L	M	L	M	-	-	-
CO2	M	-	-	-	L	L	-	L	M	M	-	L	-	-	M
CO3	S	S	M	S	S	-	-	L	-	L	-	L	L	M	L
CO4	L	M	S	L	M	-	L	-	L	M	L	M	-	-	-
CO5	L	L	M	-	L	M	S	S	M	L	L	M	-	-	M

S- Strong; M-Medium; L-Low

SYLLABUS:

INTRODUCTION

Concept of Quality and Quality Management - Determinants of quality of product & service - Quality costs – Analysis Techniques for Quality Costs – TQM Principles and Barriers & Implementation –Leadership – Concepts- Role of Top Management- Quality Council – Quality statements: vision, mission, Policy - SMART Goal setting - Strategic Planning.

TQM PRINCIPLES AND PHILOSOPHIES

Customer satisfaction – Perception of Quality- Customer Complaints - Service Quality- Customer Retention- Employee Involvement – Motivation- Empowerment – Teams - Recognition and Reward- Performance Appraisal - Continuous Process Improvement: Deming's Philosophy - Juran's Trilogy - PDSA Cycle- Taguchi Quality Loss Function - 5S principles and 8D methodology - Kaizen - Basic Concepts.

STATISTICAL PROCESS CONTROL (SPC) & PROCESS CAPABILITY

Statistical Fundamentals – Measures of central Tendency & Dispersion - Population and Sample- Normal Curve- Control Charts for variables and attributes - OC curve - Process capability- Concept of six sigma- The Seven tools of Quality - New seven Management tools.

TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT

Benchmarking – Reasons - Process- Quality Function Deployment (QFD) – House of Quality- QFD Process- Benefits- Total Productive Maintenance (TPM) – Concept- Improvement Needs- FMEA – Stages of FMEA - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

QUALITY SYSTEMS

Introduction to IS/ISO 9004:2000 – quality management systems – Elements- Implementation of Quality System - Documentation- Quality Auditing- ISO 14000 – Concept- Requirements and Benefits.

TEXT BOOKS:

1. Dale H.Besterfiled- et at. - Total Quality Management- PHI-1999. (Indian reprint 2002).
2. Feigenbaum.A.V. "Total Quality Management- McGraw-Hill- 1991.

REFERENCES:

1. James R.Evans & William M.Lidsay - The Management and Control of Quality- (5th Edition) - South-Western (Thomson Learning) - 2002 (ISBN 0-324-06680-5).
2. Oakland.J.S. "Total Quality Management Butterworth – Hcinemann Ltd - Oxford. 1989.
3. Narayana V and Sreenivasan - N.S. Quality Management – Concepts and Tasks- New Age International 1996.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	A. Mani	Associate Professor	Management Studies	mani@vmkvec.edu.in
2	Dr. V. Sheela Mary	Associate Professor	Management Studies	sheelamary@avit.ac.in

34121H05	ENGINEERING MANAGEMENT AND ETHICS	Category	L	T	P	Credit
		FC-HS	3	0	0	3

PREAMBLE:

Engineering management provides technological problem-solving ability of engineering and the organizational to oversee the operational performance of complex engineering enterprises to Engineers. Engineers require honesty, impartiality, fairness, and equity, and dedication to the protection of the public health, safety, and welfare. Ethics emphasises the importance of moral issues, rights and duties of the employees through basic ethics confronting individuals and organizations engaged. It also emphasise values that are morally desirable in engineering practice and research. It allows them to understand various occupational crimes and learn the moral leadership.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To Understand the principles of planning at various levels of the organisation.
2. To analyse and practice the concepts of organizing, staffing to higher productivity.
3. To apply the concepts related to directing and controlling.
4. To understand and apply the case studies to practice code of ethics in organisation.
5. To apply the ethical principles in working environment.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the importance of planning principles in organization	Understand
CO2: Apply the various strategies of organising and staffing process.	Apply
CO3: Analyse various leadership skills and control techniques for shaping the organization.	Analyse
CO4: Understand and apply best ethical practices in organisation	Analyse
CO5: Analyse and Apply relevant ethical practices in engineering.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	L	S	M	M	L	S	S	S	S	-	-	-
CO2	M	L	L	-	M	M	M	L	M	S	M	M	-	-	-
CO3	M	M	L	-	M	M	M	L	L	S	S	M	-	-	-
CO4	L	M	-	M	-	M	S	S	S	S	-	M	-	-	-
CO5	M	M	-	L	-	M	S	S	S	S	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

PLANNING

Nature and purpose of planning – planning process – types of planning – objectives – setting -Objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

ORGANISING

Nature and purpose – Formal and informal organization – organization chart – organization structure– types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

DIRECTING

Foundations of individual and group behavior – motivation – motivation theories – motivational - Techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – Communication – process of communication – barrier in communication – effective communication – communication and IT.

CONTROLLING

System and process of controlling – budgetary and non-budgetary control techniques – use of Computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

ETHICS IN ENGINEERING

Moral dilemmas -Uses of Ethical Theories- Engineering As Social Experimentation- Engineer's Responsibility For Safety-Codes of Ethics-Challenger - Employed Engineers Rights and Duties- Collective Bargaining - Occupational Crime - Global Issues- Multinational Corporation- Technology transfer - Engineers as managers - Consulting Engineers - Expert Witness-Moral Leadership.

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson South-western, 7th edition, 2007.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	mail id
1	M. Manickam	Associate Professor	Management Studies	manickam@vmkvec.edu.in
2	Mr. T. Thangaraja	Assistant Professor	Management Studies	thangaraja@avit.ac.in

		Category	L	T	P	C
34121H83	UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY	FC-HS	3	0	0	3

Course Objectives:

1. Development of a holistic perspective based on self- exploration

2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act.

UNIT I Introduction

Value Education, Definition, Concept and Need for Value Education-Content and Process of -basic guidelines for Value Education -Self exploration - Happiness and Prosperity as parts of Value Education.

UNIT II Understanding Harmony in the Human Being

Harmony in Myself-Understanding human being as a co-existence of the sentient 'I' and the material 'Body'-Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. -Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I'-Understanding the harmony of I with the Body-Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

UNIT III Understanding Harmony in the Family and Society

Harmony in Human-Human Relationship -meaning of Justice - Trust and Respect -Difference between intention and competence- respect and differentiation; the other salient values in relationship Understanding the harmony in the society - Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals –Gratitude

UNIT IV Understanding Harmony in the Nature and Existence

Whole existence as Coexistence -Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature-Holistic perception of harmony at all levels of existence.

UNIT V Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values -Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order- Competence in professional ethics

Total Hours: 45 Hours

Text Book

1.Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.

COURSE DESIGNERS				
S.NO	**COURSE INSTRUCTOR**	**DESIGNATION**	**NAME OF THE INSTITUTION**	**MAIL ID**
1	Dr.S.P.Sangeetha	Vice Principal(Academics)	AVIT	sangeetha@avit.ac.in
2	Dr. Jennifer G Joseph	HoD-H&S	AVIT	Jennifer@avit.ac.in

		Category	L	T	P	Credit
34121H08	**OPERATIONS MANAGEMENT**	**FC-HS**	**3**	**0**	**0**	**3**

PREAMBLE:

The contemporary uncertain business environment is forcing the organizations to adopt the latest tools, techniques and strategies for managing their resources in the most effective and efficient fashion. 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- impressive 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, forecasting, facility planning and layout, aggregate production planning, capacity planning, project management, production control, materials management, inventory and quality management, JIT and Kanban System.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the Fundamentals of Operations.
2. To Understand the importance of Job Design and their relationship towards Efficiency.
3. To understand the importance of Production, Planning and Control.
4. To evaluate the material requirement with the techniques.
5. To impart the Operation management Techniques to get rid of the Competitive advantage.

COURSE OUTCOMES:	
CO1. Understand the importance of Operations Management.	Understand
CO2. Evaluating the various organisation and staffing functions	Evaluate
CO3. Understand the Importance of Production Planning and Control.	Understand
CO4. Evaluate the Various Operation Management Techniques	Evaluate
CO5. Analyze and Evaluating the various Inventory Management Techniques to take Competitive advantage.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	L	S	L	S	L	L	L	L	L	-	-	-
CO2	S	S	M	M	-	L	L	M	M	L	L	M	-	-	-
CO3	S	S	S	S	S	M	L	S	M	L	L	L	-	-	-
CO4	M	M	S	S	M	L	L	M	M	L	L	L	-	-	-
CO5	S	S	S	S	M	M	S	L	M	M	S	L	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

UNIT- I INTRODUCTION TO OPERATIONS MANAGEMENT **9 Hours**

Operations Management- Nature & Scope – Evolution of Operations Management – Types of Production System, Operations Strategy – Product Life Cycle- Value Engineering concepts - Make or Buy Decision- Recent Trends in Operations Management- Plant Capacity - Plant Location & Factors.

UNIT-II JOB DESIGN & MATERIAL HANDLING **9 Hours**

Layout- Principles of Layout- Factory-Basic types of layout product layout, group technology layout, fixed position layout, Retail service layout. Principles of material handling-Material handling equipment. Job-design: Effective job design- Combining engineering and behavioral approaches, Work measurement- method analysis- Ergonomics-Case studies.

UNIT- III PRODUCTION, PLANNING & CONTROL

Hours

Basic types of production- Interminent, Batch, continuous-Routing, Scheduling, Activating and Monitoring-Production Planning and Control, Process Planning, Aggregate Production Planning, Capacity Planning: Introduction, Capacity Planning

UNIT IV OPERATION TECHNIQUES

9 Hours

Project Scheduling, Network Diagrams, Critical Path Method (CPM), Critical Path Method: Problems, Critical Path Method. Program Evaluation and Review Technique (PERT), PERT Problems, PERT Problems, Time Cost Trade Off Production Control, Sequencing, Sequencing Problems-I, Sequencing Problems- II, Master Production Scheduling- Concept of Quality, Total Quality Management (TQM), Total Productive Maintenance (TPM), Statistical Quality Control (SQC), Six Sigma.

UNIT- V INVENTROY MANAGEMENT

9 Hours

Materials Management, Inventory Control, Economic Order Quantity (EOQ) Models, Economic Order Quantity (EOQ): Problems, Production Quantity- Just in Time (JIT), Kanban System, Materials Requirement Planning (MRP)-I, Materials Requirement Planning (MRP)-II, Enterprise Resource Planning (ERP).

TEXT BOOKS:

1.Operation Management: K. N. Dervitsiotis, McGraw-Hill International Company.
2.Operations Management: R.S. Russell, and B.W. Taylor, Pearson Education
3.Industrial Engineering and Production Management: M. Telsang, S. Chand & Company Ltd.

REFERENCES:

1. The Encyclopedia of Operations Management: A Field Manual and Glossary of Operations Management ARTHUR V HILL 1st Edition.
2. Handbook of Industrial Engineering: Technology and Operations Management, Gavriel Salvendy 3rd Edition.
3. Quality and Operations Management: Revised Edition.
4. Operations Management: Theory and Practice by Mahadevan
5. Production and Operations Management by PANNEERSELVAM. R.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	mail id
1	Dr. B. Rajnarayanan	Associate Professor	Management Studies	rajnarayanan@vmkvec.edu.in
2	Mr. T. Thangaraja	Associate Professor	Management Studies	thangaraja@avit.ac.in

34121H11	SOFT SKILLS FOR ENGINEERS	Category	L	T	P	Credit
		FC-HS	3	0	0	3

PREAMBLE

Technical English is a life skill course necessary for all students of Engineering and Technology. It aims at developing communication skills in English, essential for understanding and expressing the ideas of different professional context. The outcome of the course is to help the students acquire the language skills of Listening, Speaking, Reading and Writing competency in English language and thereby making the students competent and employable in the globalised scenario.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To enable students to develop LSRW skills in English. (Listening, Speaking, Reading, and Writing.)
2	To make them become effective communicators.
3	To ensure that learners use Electronic media materials for developing language.
4	To aid the students with employability skills.
5	To develop the students communication skills in formal and informal situations.

COURSE OUTCOMES

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

CO1. Listen, remember and respond to others in different scenario	Remember
CO2. Understand and speak fluently and correctly with correct pronunciation in different situation.	Understand
CO3. To make the students experts in professional writing	Apply
CO4. To make the students in proficient technical communicator	Apply
CO5 To make the students recognize the role of technical writing in their careers in business, technical and scientific field	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-		-	**M**	**M**	**M**	-	**S**	-	**S**	**S**	-	**S**
CO2	-	-	-		-	-	**L**	-	-	**S**	-	**S**	-	-	**S**
CO3	-	-	-	**L**	-	-	-	-	-		-	**L**	-	**M**	-
CO4	-	-	-		-	**M**	-	**L**	**M**	**S**	**L**	**S**	**S**	**M**	**S**
CO5	**M**	-	**L**	**S**	-	-	-	-	-	-	-	**S**	**M**	-	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO SOFT SKILLS

Aspects of Soft Skills, Effective Communication Skills, Classification of Communication, Telephonic Communication Skills, Communicating without Words, Paralanguage.

INTERPERSONAL SKILLS

Group Communication Skills, Leadership Skills, Group Discussion, Meeting Management, Adaptability & Work Ethics, Personality development Positive Thinking, Proxemics, Haptics: The Language of Touch, Meta-communication, Applied Grammar.

LIFE SKILLS

Emotional Intelligence, Critical Thinking, Decision making, Problem solving, Listening Skills, Types of Listening, Negotiation Skills, Culture as Communication, Communication Breakdown, Organizational Communication.

PROFESSIONAL WRITING SKILLS

Advanced Writing Skills, Principles of Business Writing, Business Letters: Format and Style, Types of Business Letter writing, Reports, Types of Report, Strategies for Report Writing, Evaluation and Organization of Data Structure and Style of Report.

CAREER SKILLS

Advanced Speaking Skills, Speeches & Debates, Combating Nervousness, Patterns & Methods of Presentation, Oral Presentation: Planning & Preparation, Making Effective Presentations, Speeches for Various Occasions, Interviews, Planning & Preparing: Effective Résumé, Facing Job Interviews.

TEXT BOOK

1. English for Engineers- Faculty of English – VMKV Engineering College, Salem and AVIT, Chennai

REFERENCE BOOKS

1. English for Effective Communication, Department of English, VMKV & AVIT, SCM Publishers, 2009.
2. Practical English Usage- Michael Swan (III edition), Oxford University Press
3. Grammar Builder- I, II, III, and Cambridge University Press.

4 Pickett and Laster. Technical English: Writing, Reading and Speaking, New York: Harper and Row Publications, 2002.

Course Designers:

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2	Dr Bhuvaneswari R/ Assistant Professor - English	bhuvaneswarir@vmkvec.edu.in

BASIC SCIENCE COURSES

		Category	L	T	P	Credit
34121B01	ENGINEERING MATHEMATICS	FC-BS	2	1	0	3

Preamble

The driving force in Engineering Mathematics is the rapid growth of technology and the sciences. Matrices had been found to be of great utility in many branches of engineering applications such as theory of electric circuits, aerodynamics, and mechanics and so on. Many physical laws and relation can be expressed mathematically in the form of differential equations. Based on this we provide a course in matrices, calculus and differential equations. Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals.

Prerequisite : NIL

Course Objectives

1	To recall the advanced matrix knowledge to Engineering problems.
2	To equip themselves familiar with the functions of several variables.
3	To improve their ability in solving geometrical applications of differential calculus problems.
4	To examine knowledge in multiple integrals.
5	To improve their ability in Vector calculus.

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

CO1.	Apply the concept of orthogonal reduction to diagonalize the given matrix.	Apply
CO2.	Find the radius of curvature, circle of curvature and centre of curvature for a given curve.	Apply
CO3.	Classify the maxima and minima for a given function with several variables, through by finding stationary points	Apply
CO4.	Find double integral over general areas and triple integral over general volumes	Apply
CO5.	Apply Gauss Divergence theorem for evaluating the surface integral.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	-	-	-	L	-	-	-	M	-	-	-
CO2	S	S	M	-	-	-	-	L	-	-	-	M	-	-	-
CO3	S	S	M	-	-	-	-	L	-	-	-	M	-	-	-
CO4	S	S	M	-	-	-	-	L	-	-	-	M	-	-	-
CO5	S	S	M	-	-	-	-	L	-	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

MATRICES

Characteristic equation – Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) – Cayley-Hamilton theorem (excluding proof).

DIFFERENTIAL CALCULUS&PARTIAL DERIVATIVES

Curvature – Cartesian and Parametric Co-ordinates – Centre and radius of curvature – Circle of curvature. Partial Derivatives – Total Differentiation – Maxima and Minima -Constrained Maxima and Minima by Lagrangian Multiplier Method.

ORDINARY DIFFERENTIAL EQUATIONS

Solutions of second and third order linear ordinary differential equation with constant coefficients – Method of variation of parameters -Simultaneous first order linear equations with constant coefficients.

MULTIPLE INTEGRALS

Introduction of multiple integration by examples of Double and Triple integral-Evaluation of double and Triple Integration (in both Cartesian and polar coordinates)-Change of order of integration**.**

VECTOR CALCULUS

Scalar and vector point functions, Gradient, divergence, curl, Solenoidal and irrotational vectors, Vector identities (without proof), Normal and Directional derivatives, Solenoidal and irrotational field, Integration of vectors: Definition of Line, surface and volume integrals, Green's, Gaussdivergence and Stoke's theorems (Statements only)

Text Books

1. Veerarajan T., "Engineering Mathematics", Tata McGraw Hill Education Pvt, New Delhi (2019).
2. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delh (2020).
3. Kreyszig E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore (2012).

Reference Books

1. Engineering Mathematics", Department of Mathematics, VMKVEC (Salem) & AVIT (Chennai), (2017).
2. Dr.A.Singaravelu, "Engineering Mathematics I & II", 23rd Edition, Meenakshi Agency, Chennai (2016).

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	Nil			

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. A.K.Bhuvaneswari	Assistant Professor	Mathematics/AVIT	bhuvaneswari@avit.ac.in
2	Dr.G.Selvam	Associate Professor	Mathematics/VMKVEC	selvam@vmkvec.edu.in

		Category	L	T	P	Credit
34121B04	PHYSICAL SCIENCES PART A - ENGINEERING PHYSICS	FC-BS	2	0	0	2

PREAMBLE

Engineering Physics is the study of advanced physics concepts and their applications in various technological and engineering domains. Understanding the concepts of laser, types of lasers, the propagation of light through fibers, applications of optical fibers in communication, production and applications of ultrasonics will help an engineer to analyze, design and to fabricate various conceptual based devices.

PREREQUISITE :NIL

COURSE OBJECTIVES

1	To recall the properties of laser and to explain principles of laser.
2	To assess the applications of laser.
3	To detail the principles of fiber optics.
4	To study the applications of fiber optics.
5	To explain various techniques used in Non-destructive testing.

COURSE OUTCOMES

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

CO1. Understand the principles laser, fiber optics and ultrasonics	Understand
CO2. Understand the construction of laser, fiber optic and ultrasonic equipments	Understand
CO3. Demonstrate the working of laser, fiber optic and ultrasonic based components and devices	Apply
CO4. Interpret the potential applications of laser, fiber optics and ultrasonics in various fields	Apply
CO5. Differentiate the working modes of various types of laser, fiber optic and ultrasonic devices.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	-	M	-	-	-	-	-	-	-	-	M	M	-	M
CO2	S	-	L	-	-	-	-	-	-	-	-	M	M	-	-
CO3	S	-	-	M	-	-	M	-	-	-	-	M	M	-	-
CO4	S	M	-	M	M	S	M	-	-	-	-	M	S	-	M
CO5	S	M	M	-	-	-	-	-	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

LASERS: Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd: YAG laser, CO2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram.

FIBRE OPTICS: Principle and propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – Applications: Fiber optic communication system – fiber optic displacement sensor and pressure sensor.

ULTRASONICS: Ultrasonic production: Magnetostriction and piezo electric methods – Determination of velocity of ultrasonic waves (acoustic grating) – Applications of ultrasonics

TEXT BOOK

1. Engineering Physics, compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.
2. Palanisamy P. K., Engineering Physics, Scientific Publishers, 2011.
3. Avadhanulu M. N., Kshirsagar P. G., Arun Murthy T. V. S., A Textbook of Engineering Physics, S. Chand Publishing, 2018.

REFERENCE BOOKS

1. Beiser, Arthur, Concepts of Modern Physics, 5th Edition, McGraw-Hill, 2009.
2. Halliday.D, Resnick.R, Walker.J, Fundamentals of Physics, Wiley & sons, 2013.
3. Gaur R. K. and Gupta S. L., Engineering Physics, DhanpatRai publishers, New Delhi, 2012.
4. Srivastava S. K., Laser Systems and Applications 3rd Edition, New Age International (P) Ltd Publishers, 2019.
5. Ajoy Ghatak, Thyagarajan K., Introduction To Fiber Optics, Cambridge India, 2013.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in

	PHYSICAL SCIENCES PART-B -ENGINEERING CHEMISTRY (Common to all Branches)	Category	L	T	P	Credit
34121B04		FC-BS	2	0	0	2

Preamble

The objective of this course is to better understand the basic concepts of chemistry and its applications in diverse engineering domains. It also imparts knowledge on the properties of water and its treatment methods, Electrochemistry, corrosion and batteries, properties of fuel and combustion. This course also provides an idea to select the material for various engineering applications and their characterization.

Prerequisite : NIL

Course Objectives

1	To Provide the knowledge on water treatment.
2	To explain about the importance of electrochemistry, mechanism of different corrosion and principle and working of batteries.
3	To explain different types of fuel, properties and its important features.

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

CO1	Estimate the hardness of water Apply and Identify suitable water treatment methods.	Apply
CO2	Describe terms involved in electrochemistry, the control methods of corrosion and working of energy storage devices.	Analyze
CO3	Understand the quality of fuels from its properties and the important features of fuels	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	-	M	S	M	-	-	-	M	M	M	M
CO2	S	S	L	L	-	S	S	S	-	-	-	S	M	L	M
CO3	S	M	M	L	L	L	M	M	-	-	-	S	-	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

WATER TECHNOLOGY

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA. Boiler troubles - Treatment of boiler feed water – Internal treatment (phosphate, colloidal sodium aluminate and calgon conditioning). External treatment – Ion exchange process, zeolit process – Domestic water treatment - desalination of brackish water – Reverse Osmosis and Electrodialysis.

ELECTROCHEMISTRY, CORROSION AND BATTERIES

Electrochemistry: Electrode potential - Nernst equation – Electrodes (SHE, Calomel and Glass) Galvanic cell- Electrochemical cell representation - EMF series and its significance. Corrosion - Definition causes and effects, Classification, Types of corrosion- dry corrosion, Wet corrosion, Factor influencing rate of corrosion, Corrosion control methods – Sacrificial anode method and impressed

current cathodic method.

Batteries: Terminology- Daniel cell – Dry cell - Lead-acid accumulator- Nickel-Cadmium batteries. Lithium batteries: Li/SOCl2 cell - Li/I2 cell- Lithium ion batteries. Fuel cells: Hydrogen-oxygen fuel cell, Solid oxide fuel cell (SOFC)

FUELS AND COMBUSTION

Fuels: Introduction – classification of fuels – coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number – cetane number – natural gas – compressed natural gas (CNG). Liquefied petroleum gases (LPG) – power alcohol and biodiesel. Combustion of fuels: Introduction – calorific value – higher and lower calorific values-theoretical calculation of calorific value – ignition temperature – spontaneous ignition temperature – explosive range – flue gas analysis (ORSAT Method).

Text Books

1. Engineering Chemistry by Jain and Jain, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2017
2. A text book of Engineering Chemistry by S.S. Dara, S.Chand & company Ltd., New Delhi
3. A text book of Engineering Chemistry by Shashi Chawla, Edition 2012 Dhanpatrai & Co., New Delhi.

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, 3rd Edition, McGraw Hill, 1980
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins, Julio de Paula, 8th Edition, Oxford University press, 2007
Engineering Chemistry by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. A.R. Sasieekhumar	Assistant Professor	CHEM/ VMKVEC	sasieekhumar@vmkvec.edu.in
2	Dr. R. Nagalakshmi	Professor	CHEM/ AVIT	nagalakshmi.chemistry@avit.ac.in

		CATEGORY	L	T	P	C
34121B12	**SMART MATERIALS**	**FC-BS**	**3**	**0**	**0**	**3**

PREAMBLE

Smart Materials gives an outlook about various types of materials having potential application in Engineering and Technology. In particular, Students learn about Properties of Crystalline Materials, Smart Materials and Nanomaterials, and their industrial applications, characteristics and industrial applications of Magnetic and Superconducting materials.

PREREQUISITE:

Nil

COURSE OBJECTIVES:

1	To understand the structure of crystalline materials.
2	To understand the properties of smart materials and realize its industrial applications.
3	To learn the synthesis of Nano materials and carbon nanotubes.
4	To learn the properties, classification and relevant applications of magnetic materials.
5	To understand the concept of superconductivity, properties of super conductor and their industrial applications.

COURSE OUTCOMES:

After successful completion of the course, learner will be able to

CO1. Learn the structure of Crystalline Materials	Apply
CO2. Gain the basic knowledge and recognize the applications of Smart Materials	Apply
CO3. Get an exposure about the properties of Nano materials	Apply
CO4. Gain the knowledge about the properties of magnetic materials and familiarize their applications.	Apply
CO5. Gain the knowledge about Superconducting materials	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PO S1	PO S2	POS3
CO1	S	S	S	S	M	-	-	-	-	-	-	S	-	-	-
CO2	S	M	S	S	-	-	-	-	-	-	-	S	-	-	-
CO3	S	S	S	S	M	-	-	-	-	-	-	S	-	-	-
CO4	S	S	S	S	-	-	-	-	-	-	-	S	-	-	-
CO5	S	M	M	S	M	-	-	-	-	-	-	S	-	-	-

S – strong, M- Medium, L – Low

SYLLABUS

CRYSTALLINE MATERIALS: Unit cell – Bravais lattice – Miller indices – Calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures – determination of interplanar distance (d).

SMART MATERIALS: Shape Memory Alloys (SMA) – Characteristics and properties of SMA, Application – SMA in Actuators and Blood clot filters, advantages and disadvantages of SMA. Metallic glasses – Preparation, properties and industrial applications (Core of the Transformer).

NANO MATERIALS: Nanophase materials – Top-down approach - Mechanical Grinding - Lithography - Bottom-up approach – Sol-gel method – Carbon nanotubes – Fabrication – applications; Chemical Sensors.

MAGNETIC MATERIALS: Basic concepts – Classification of magnetic materials – Domain theory – Hysteresis – Soft and Hard magnetic materials – Applications of Magnetic materials (Magnets in Generators and MRI scan).

SUPER CONDUCTING MATERIALS: Superconducting phenomena – properties of superconductors – Meissner effect – isotope effect – Type I and Type II superconductors – High Tc Superconductors – Industrial Applications of superconductors (SQUID, Cryotrons and Maglev Trains).

TEXT BOOKS

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2015.
2. A.K. Katiyar and C.K. Pandey, Engineering Physics Theory and Practical, Wiley Publisher, 2015.

REFERENCES

1. Pillai S.O., Solid State Physics, 9th Edition, New Age International (P) Ltd., Publishers, 2020.
2. William D. Callister Jr., David G. Rethwisch., Materials Science and Engineering: An Introduction, 10th Edition, Wiley Publisher, 2018.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. Suresh	Associate Professor	Physics	suresh.physics@avit.ac.in
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		Category	L	T	P	Credit
34121B81	PHYSICAL SCIENCES LAB PART A – REAL AND VIRTUAL LAB IN PHYSICS	FC-BS	0	0	2	1

PREAMBLE

In this laboratory, experiments are based on the calculation of physical parameters like young's modulus, rigidity modulus, viscosity of water, wavelength of spectral lines, thermal conductivity and band gap. Some of the experiments involve the determination of the dimension of objects like the size of a microparticle and thickness of a thin wire. In addition to the above real lab experiments, students gain hands-on experience in virtual laboratory.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To impart basic skills in taking reading with precision of physics experiments.
2	To inculcate the habit of handling equipments appropriately.
3	To gain the knowledge of practicing experiments through virtual laboratory.
4	To know the importance of units.
5	To obtain results with accuracy.

COURSE OUTCOMES

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

CO1. Recognize the importance of units while performing the experiments, calculating the physical parameters and obtaining results	Understand
CO2. Operate the equipments with precision	Apply
CO3. Practice to handle the equipments in a systematic manner	Apply
CO4. Demonstrate the experiments through virtual laboratory	Apply
CO5. Calculate the result with accuracy	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	S	S													
CO2	S	S	M	M	S				M			M	M		M
CO3	S														
CO4	S	S	M	M	S							S	M		M
CO5	S	S													

S- Strong; M-Medium; L-Low

SYLLABUS

1. Young's modulus of a bar - Non-uniform bending
2. Rigidity modulus of a wire - Torsional Pendulum
3. Viscosity of a liquid - Poiseuille's method
4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer
5. Particle size determination using Laser
6. Wavelength of spectral lines – grating – Spectrometer
7. Thickness of a wire - Air wedge Method

8. Thermal conductivity of a bad conductor - Lee's disc
9. Band gap determination of a thermistor - Post Office Box
10. Specific resistance of a wire – Potentiometer

LAB MANUAL

Physical Sciences Lab: Part A – Real And Virtual Lab In Physics Manual compiled by Department of Physics, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. C. SENTHIL KUMAR	PROFESSOR	PHYSICS	senthilkumarc@vmkvec.edu.in
2	Dr. R. SETHUPATHI	ASSOCIATE PROFESSSOR	PHYSICS	sethupathi@vmkvec.edu.in

	PHYSICAL SCIENCES PART-B - ENGINEERING CHEMISTRY LAB (Common to all Branches)	Category	L	T	P	Credit
34121B81		FC-BS	0	0	2	1

Preamble

Engineering Chemistry Lab experiments explains the basics and essentials of Engineering Chemistry. It also helps the students to understand the applications of Engineering Chemistry. The electrodes, Cell and batteries study gives clear basic application oriented knowledge about electrochemistry. Water technology study gives the idea about hardness and its disadvantages. Now-a-days the practical and handling of equipments are needed for our fast growing life style.

Prerequisite:

NIL

Course Objectives

1	To impart basic skills in Chemistry so that the student will understand the engineering concept.
2	To inculcate the knowledge of water and electrochemistry.
3	To lay foundation for practical applications of chemistry in engineering aspects.

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

CO1	Understand the basic skills for his/her future studies.	Understand
CO2	Analyze the water comprehensively.	Apply
CO3	Apply the practical knowledge in engineering aspects.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	L	M	M	S	-	-	-	M	-	-	-
CO2	S	M	M	-	L	M	M	L	-	-	-	M	-	-	-
CO3	S	S	M	-	L	M	M	M	-	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Determination of Hardness by EDTA method
2. Estimation of Hydrochloric acid by conductometric method
3. Acid Base titration by pH method
4. Estimation of Ferrous ion by Potentiometric method
5. Determination of Dissolved oxygen by Winkler's method
6. Estimation of Sodium by Flame photometer
7. Estimation of Copper from Copper Ore Solution
8. Estimation of Iron by Spectrophotometer

Text Books

1. Engineering Chemistry Lab Manual by VMU. Delhi.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. R. Nagalakshmi	Professor	CHEM/ AVIT	nagalakshmi.chemistry@avit.ac.in
2	A. Gilbert Sunderraj	Assistant Professor	CHEM/ VMKVEC	gilbertsunderraj@vmkvec. edu.in

		Category	L	T	P	Credit
34121B24	**INDUSTRIAL MATERIALS**	**FC-BS**	**3**	**0**	**0**	**3**

Preamble:

Industrial Material is a part of the long chain in the design and manufacturing process. It deals with the ideas, the design, the testing, and prototyping of new industrial products. To solve the major problems of the world and their essential skills are, in-depth knowledge and application of chemistry and creativity with chemicals.

Prerequisite : NIL

Course Objectives

1	To Describe the various metallic materials.
2	To Apply the various smart materials for industries.
3	To Distinguish the lubricants in the industries.
4	To Categorize various types of paints using in the industries.
5	To Distinguish the various petroleum products.

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

CO1.	Discuss the various metallic materials using in industries.	Understand
CO2.	Interpret the various smart materials and its applications.	Apply
CO3.	Compare the different lubricants with their properties.	Analyze
CO4.	Relate the various surface coatings.	Apply
CO5.	Categorize the different petroleum products.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	M	S	-	-	-	-	-	M	M	M
CO2	S	M	-	-	-	S	S	-	-	-	-	-	M	M	M
CO3	S	M	-	-	-	S	M	-	-	-	-	-	M	M	M
CO4	S	S	-	-	-	M	S	-	-	-	-	-	M	M	M
CO5	S	S	-	-	-	S	M	-	-	-	-	-	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

METALS AND ALLOYS

Engineering materials: Ferrous materials, Aluminium, Copper, Nickel, Magnesium, Titanium alloys for engineering applications. Phase diagrams, properties and typical alloys with reference to their applications.

SMART MATERIALS

Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications, Polymers and Plastics from industry. Development, important properties and smart applications of polymeric materials.

LUBRICANTS

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pour point) and their determination.

PAINTS

surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings- Paints, pigments, Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents.

Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

PETROLEUM AND PETROCHEMICAL INDUSTRY

Composition of crude petroleum- Refining and different types of petroleum products and their applications - Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass) - synthetic fuels (gases and liquids).

Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Text Books

1. Industrial chemistry by B.K.Sharma. Goel publishing home.
2. Engineering Material Technology, 5th edition, by James A.Jacobs & Thomas F. Kilduff.

Reference Books

1. An Introduction to Industrial chemistry by C,A.Heaton. Springer publications.
2. Engineering materials1: An introduction to properties, applications and design by Michael F Ashby and David R H Jones, Elsevier Butterworth Heinmann Publishers, 2007

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Mr.A.Gilbert sunderraj	Associate Professor	Chemistry/VMKVEC	gilbertsunderraj@vmkvec.edu.in
2	Dr.R.Nagalakshmi	Professor	Chemistry/AVIT	nagalakshmi.chemistry@avit.ac.in

	MATHEMATICS FOR MECHANICAL SCIENCES	**Category**	**L**	**T**	**P**	**Credit**
34121B11		**FC-BS**	**2**	**1**	**0**	**3**

Preamble

This course provides a solid undergraduate foundation in partial differential equations, probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the real world. Partial differential equations are derived from physics and instruct the methods for solving boundary value problems, that is, methods of obtaining solutions which satisfy the conditions required by the physical situations such as Heat flow equations of one dimension and two dimensions. Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines. Statistics is permeated by probability. Statistics has been responsible for accelerating progress in all applied sciences by defining the correct methods of planning, collecting, analyzing and interpreting data for establishing cause and effect relationship.

Prerequisite : Engineering Mathematics

Course Objectives

1	To formulate and solve partial differential equations.
2	To represent a periodic function as a Fourier series.
3	To be familiar with applications of partial differential equations.
4	To provide an understanding for the graduate on statistical concepts to include measures of central tendency, curve fitting, correlation and regression.
5	To be familiar with discrete and continuous random variables.

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

CO1.	Explain the methodology of forming and solving partial differential equations.	Apply
CO2.	Demonstrate periodic functions arising in the study of engineering problems as Fourier series of sine and cosines and compute the Fourier coefficients numerically.	Apply
CO3.	Solve partial differential equations arising in engineering problems like wave equations and heat flow equation by Fourier series	Apply
CO4.	Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data	Apply
CO5.	Apply concepts of probability, discrete and continuous random variables.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**M**	**M**	**L**	**--**	**--**	**--**	**--**	**M**	**--**	**--**	**--**	**M**	**--**	**--**	**--**
CO2	**S**	**M**	**M**	**L**	**--**	**--**	**--**	**M**	**--**	**--**	**--**	**M**	**--**	**--**	**--**
CO3	**S**	**M**	**M**	**L**	**--**	**--**	**--**	**M**	**--**	**--**	**--**	**M**	**--**	**--**	**--**
CO4	**S**	**M**	**L**	**--**	**--**	**--**	**--**	**M**	**--**	**--**	**--**	**M**	**--**	**--**	**--**
CO5	**S**	**S**	**M**	**L**	**--**	**--**	**--**	**M**	**--**	**--**	**--**	**M**	**--**	**--**	**--**

S- Strong; M-Medium; L-Low

SYLLABUS

PARTIAL DIFFERENTIAL EQUATIONS
Formation - Solutions of standard types f(p,q)=0, clairauts form, f(z,p,q)=0,f(p,x)=g(q,y) of first order equations - Lagrange's Linear equation - Linear partial differential equations of second and higher order with constant coefficients.
FOURIER SERIES
Dirichlet's conditions – General Fourier series – Half -range Sine and Cosine series – Parseval's identity – Harmonic Analysis.
BOUNDARY VALUE PROBLEMS
Classification of second order linear partial differential equations – Solutions of one – dimensional wave equation, one – dimensional heat equation – Steady state solution of two – dimensional heat equation – Fourier series solutions in Cartesian coordinates.
STATISTICS
Measures of central tendency, Curve fitting – Straight line and Parabola by least square method, Correlation, Rank correlation and Regression**.**
VECTOR CALCULUS
Probability Concepts – Random Variables - Discrete and Continuous Random Variables- Probability mass function – Probability density functions - Moment Generating Functions and their properties.
Text Books
1. S.C. Gupta, V.K. Kapoor, "Fundamentals of mathematical statistics", Sultan Chand & Sons (2017). 2. Grewal, B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2012). 3. T. Veerarajan, "Probability, Statistics and Random processes" 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi (2006).
Reference Books
1. Dr.A. Singaravelu, "Transforms and Partial differential Equations", 18th Edition, Meenakshi Agency, Chennai (2013). 2. Dr.A. Singaravelu, "Probability and Statistics", Meenakshi Agencies, Chennai (2016).

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	Nil			

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr. S. Punitha	Associate Professor	Mathematics/VMKVEC	punitha@vmkvec.edu.in
2	Ms. S. Sarala	Associate Professor	Mathematics/AVIT	sarala@avit.ac.in

	NUMERICAL METHODS FOR MECHANICAL	Category	L	T	P	Credit
34121B15	SCIENCES	FC-BS	2	1	0	3

Preamble

This course provides an introduction to the basic concepts and techniques of numerical solution of algebraic equation, system of algebraic equation, numerical solution of differentiation, integration, interpolations and applications to computer science and engineering, and science areas and develops problem solving skills with both theoretical and computational oriented problems.

Prerequisite: 1. Engineering Mathematics
2.Mathematics for Mechanical Sciences

Course Objectives

1	To familiar with numerical solution of linear equations.
2	To familiar with numerical solution of Non-linear equations.
3	To be get exposed to finite differences and interpolation and the numerical Differentiation and integration.
4	To find numerical solutions of ordinary differential equations.
5	To find numerical solutions of partial differential equations.

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

CO1.	Solve the system of linear algebraic equations and single non linear equations arising in the field of Mechanical Engineering.	Apply
CO2.	Apply methods to find intermediate numerical value & polynomial of numerical data.	Apply
CO3.	Apply methods to find integration, derivatives of one and two variable functions.	Apply
CO4.	Solve the initial value problems using single step and multistep methods.	Apply
CO5.	Solve the boundary value problems using finite difference methods.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	--	--	--	--	L	--	--	--	M	--	--	--
CO2	S	M	L	--	--	--	--	L	--	--	--	M	--	--	--
CO3	S	S	L	--	--	--	--	L	--	--	--	M	--	--	--
CO4	S	S	L	L	--	--	--	L	--	--	--	M	--	--	--
CO5	S	S	L	M	--	--	--	L	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

SOLUTION OF LINEAR EQUATIONS

Solution of linear system – Gaussian elimination and Gauss-Jordan methods – LU-decomposition methods – Jacobi and Gauss-Seidel iterative methods – sufficient conditions for convergence – Power method to find the dominant eigenvalue and eigenvector.

SOLUTION OF NONLINEAR EQUATIONS

Solution of nonlinear System – Bisection method – Secant method – Regula falsi method – Newton-Raphson method for $f(x) = 0$ – Order of convergence – Horner's method.

METHODS OF INTERPOLATION, NUMERICAL DIFFERENTIATION AND

INTEGRATION

Newton's forward, backward and divided difference interpolation –Lagrange's interpolation – Numerical Differentiation and Integration –Trapezoidal rule –Simpson's 1/3 and 3/8 rules -Curve fitting -Method of least squares and group averages.

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Euler's method – Euler's modified method – Taylor's method and Runge-Kutta method for simultaneous equations and 2nd order equations -Multistep methods – Milne's and Adams' methods.

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Numerical solution of Laplace equation and Poisson equation by Liebmann's method – s lution of one dimensional heat flow equation – Bender-Schmidt recurrence relation – Crank -Nicolson method – Solution of one dimensional wave equation.

Text Books

1. S.K Gupta, "Numerical Methods for Engineers", New Age International Pvt. Ltd. Publishers (2015).
2. S.R.K. Iyengar, R.K. Jain, Mahinder Kumar Jain, "Numerical methods for Scientific and Engineering Computations", New Age International publishers, 6th Edition (2012).
3. T. Veerarajan, T.Ramachandran, "Numerical Methods with Programs in C and C++", Tata McGraw-Hill (2008).

Reference Books

1. Joe D. Hoffman , Steven Frankel, "Numerical Methods for Engineers and Scientists", 3rd Edition, Tata Mc-Graw Hill.(New York) (2015).
2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", MC Graw Hill Higher Education (2010).

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	Nil			

Course Designers

S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	Dr. M.Vijayarakavan	Associate Professor	Mathematics/ VMKVEC	vijayarakavan@vmkvec.edu .in
2	Dr. S. Gayathri	Assistant Professor	Mathematics/AV IT	gayathri@avit.ac.in

		Category	L	T	P	Credit
34121B35	RESOURCE MANAGEMENT TECHNIQUES	FC-BS	2	1	0	3

PREAMBLE

Operations Research is the study of optimization techniques and its helps in solving problems in different environments that need decisions like, Inventory control problems, Maintenance and Replacement problems, Sequencing and Scheduling problems, Assignment of Jobs to applicants, Transportation problems, Network problems and Decision models. Entire subject is useful for all resource managers of various fields.

Prerequisite : NIL

Course Objectives

1	To be thorough with linear programming problem and formulate a real world problem as a mathematical programming model\
2	To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
3	To acquire skills in handling techniques of PERT, CPM and sequencing model to perform operation among various alternatives.
4	To be get exposed to the concepts of Inventory control.
5	To study decision theory and game theory techniques to analyze the real world systems.

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

CO1.	Formulate the Linear programming problem. Conceptualize the feasible region. Solve the LPP with two variables using graphical method and by simplex method.	Apply
CO2.	Solve specialized linear programming problems like the Transportation and Assignment problems.	Apply
CO3.	Solve network problems using CPM, PERT techniques and sequencing model.	Apply
CO4.	Design a continuous or periodic review inventory control system	Apply
CO5.	Work in a team, specifically to solve larger problem, communicate technical knowledge. Partition a problem into smaller tasks and complete tasks on time.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	M	L	--	--	S	--	--	--	S	--	--	--
CO2	S	S	M	L	L	--	--	S	--	--	--	S	--	--	--
CO3	S	S	M	L	S	--	--	S	--	--	--	S	--	--	--
CO4	S	S	S	M	--	--	--	S	--	--	--	S	--	--	--
CO5	S	S	S	M	M	--	--	S	--	--	--	S	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

LINEAR MODELS: Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, Graphical method, Simplex Method – The Big –M

method –Duality principle

TRANSPORTATION AND ASSIGNMENT MODELS: Transportations problem: North West Corner Method, Least Cost Method, Vogel's Approximation Method, Modified Distribution Method, Unbalance and Degeneracy in Transportation Model, Assignment problem: Hungarian algorithm, Unbalanced Assignment problems - Maximization case in Assignment problems, traveling salesman problem.

NETWORK MODELS: Basic terminologies, constructing a project network, network computations in CPM and PERT, Sequencing Models: Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing n jobs through m machines.

INVENTORY MODELS: Variables in inventory problems – Economic Order Quantity Model – Purchasing Model (with and without shortages) – Manufacturing Model (with and without shortages) - Stochastic Inventory Model (Stock in discrete and continuous units). Inventory models with quantity discount, safety stock, multi-item deterministic model.

DECISION MODELS: Decision Model – Game theory – Two Person Zero sum game – Algebraic solutions Graphical solutions, Matrix Oddment method for nxn games (Arithmetic Method) – Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy.

TEXTBOOKS:

1. H.A.Taha, "Operations Research: An Introduction", 10th Edition, Prentice Hall of India (2019).
2. F.S Hillier and G.J. Lieberman, "Introduction to Operations Research: Concept and Cases", McGraw-Hill International (2012).

REFERENCES:

1. Kanti Swarup, P.K.Gupta, Man Mohan, "Operations Research", S.Chand & Sons, New Delhi (2014).
2. Sundarasen.V, Ganapathy Subramaniyam, K.S, Ganesan.K. "Resource Management Techniques", A.R. Publications, Chennai (2013).
3. Premkumar Gupta, D.S. Hira, "Operations Research", S.Chand & company New Delhi (2014).

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	Nil			

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.S.Punitha	Associate Professor	Mathematics	punitha@vmkvec.edu.in
2	Dr. M.Thamizhsudar	Associate Professor	Mathematics	thamizhsudar@avit.ac.in

		Category	L	T	P	Credit
34121B18	PROBABILITY AND STATISTICS	FC-BS	2	1	0	3

Preamble

Probabilistic and statistical analysis is mostly used in varied applications in Engineering and Science. Statistical method introduces students to cognitive learning in statistics and develops skills on analyzing the data by using different tests and designing the experiments with several factors. Statistical Quality control is a method of quality control which employs statistical methods to monitor and control a process and ensure the process operates efficiently, producing more specification-conforming product. Based on this, the course aims at giving adequate exposure in random variables, probability distributions, regression and correlation, test of hypothesis and statistical quality control.

Prerequisite : Nil

Course Objectives

1	To get the knowledge on concepts of random variables and distributions with respect to how they are applied to statistical data.
2	To acquire skills in handling situations involving more than one random variable and functions of random variables
3	To acquire knowledge of Testing of Hypothesis useful in making decision and test them by means of the measurements made on the sample.
4	To be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation
5	To understand the concept of Quality control and the use of operating characteristic (OC) curves in Acceptance sampling.

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

CO1.	Select an appropriate probability distribution to determine probability function for solving engineering problem.	Apply
CO2.	Derive the marginal and conditional distributions of bivariate random variables.	Apply
CO3.	Apply the concepts of large/small sample tests into real life problems.	Apply
CO4.	Interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations.	Apply
CO5.	Prepare Control charts and decide on the in-control status of the process. Estimate whether a lot is acceptable or unacceptable based on acceptance sampling plans.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO2	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO3	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO4	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO5	S	S	M	M	--	--	--	L	--	--	--	M	--	--	--

S- Strong; M-Medium; L-Low

SYLLABUS

STANDARD DISTRIBUTION

Standard Distributions - Binomial, Poisson, Geometric, Uniform, Exponential, Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Regression Analysis

TESTING OF HYPOTHESIS

Sampling distributions – Statistical hypothesis – Testing of hypothesis for mean, variance, and proportions for large and Small Samples (Z, t and F test) - Chi-square Tests for Goodness of fit - independence of attributes.

DESIGN OF EXPERIMENTS

Analysis of Variance – One Way Classification – Two Way Classification – Completely Randomized Design – Randomized Block Design – Latin Square Design.

STATISTICAL QUALITY CONTROL

Introduction – Process control – Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling – single sampling, double sampling, multiple sampling and sequential sampling.

Text Books

1. S.P. Gupta, "Statistical Methods", 45th Edition, Sultan Chand & Sons Publishers (2017).
2. Douglas C. Montgomery and George C.Runger, "Applied Statistics and Probability for Engineers", 6th Edition, Wiley (2013).

Reference Books

1. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, New Delhi (2020).
2. Miller, "Probability and Statistics for Engineers", 9th Edition, Freund-Hall, Prentice India Ltd. (2017).

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	Nil			

Course Designers

S.No	Faculty Name	Designation	Department / Name of the College	Email id
1	Dr.M.Vijayarakavan	Associate Professor	Mathematics/VMKVEC	vijayarakavan@vmkvec.edu.in
2	Dr. A.K.Bhuvaneswari	Associate Professor	Mathematics/AVIT	bhuvaneswari@avit.ac.in

34121B19	ENVIRONMENTAL SCIENCES (Common to All Branches)	Category	L	T	P	Credit
		FC-BS	3	0	0	3

Environmental science is an interdisciplinary field that integrates physical, chemical, biological, and atmospheric sciences. Environmental studies deals with the human relations to the environment and societal problems and conserving the environment for the future. Environmental engineering focuses on the various issues of environment and its management for sustainable development by improving the environmental quality in every aspect.

PREREQUISITE
NIL

COURSE OBJECTIVES

1	To inculcate the knowledge of significance of environmental studies and conservation of the natural resources.
2	To acquire knowledge of ecosystem, biodiversity, it's threats and the need for conservation
3	To gain knowledge about environmental pollution, it's sources, effects and control measures
4	To familiarize the legal provisions and the national and international concern for the protection of environment
5	To be aware of the population on human health and environment, role of technology in monitoring human health and environment.

COURSE OUTCOMES

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

CO1. Understand the importance of environment and alternate energy resources	Understand
CO2. Initiate the awareness and recognize the social responsibility in ecosystem and biodiversity conservation	Apply
CO3. To develop technologies to analyse the air, water and soil pollution and solve the problems	Analyse
CO4. To evaluate the social issues and apply suitable environmental regulations for a sustainable development	Evaluate
CO5. To identify and analyse the urban problems, population on human health and environment	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	S	S	S	-	-	-	S	-	-	-
CO2	S	M	M	-	-	S	S	S	-	-	-	S	-	-	-
CO3	S	L	M	-	-	S	S	S	-	-	-	S	-	-	-
CO4	S	S	S	L	-	S	S	S	-	-	-	S	-	-	-

CO5	S	S	S	M	-	S	S	S	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

ENVIRONMENT AND NATURAL RESOURCES **9 hrs**

Environment - Definition, scope & importance - Public awareness- Forest resources- Use and over-exploitation, deforestation, case studies- Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems –Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, Agriculture- effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, Scope & role of engineers in conservation of natural resources.

ECOSYSTEMS AND BIO – DIVERSITY **9 hrs**

Ecosystem - Definition, structure and function - Food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest and Aquatic ecosystems – pond and sea, Introduction to biodiversity, Levels of biodiversity: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –India as a mega-diversity nation – hot-spots of biodiversity –Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **9 hrs**

Pollution - Definition, causes, effects and control measures of Air, Water and Land pollution, Solid waste- solid waste Management–Disaster management: Floods, earthquake, cyclone, landslides and tsunamis - Clean technology options, Low Carbon Life Style

SOCIAL ISSUES AND ENVIRONMENT **9 hrs**

Sustainable Development- Water conservation – rain water harvesting, watershed management -Resettlement and rehabilitation of people, case studies –Climate change - Global warming - Acid rain - Ozone depletion- Environment Protection Act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act- Pollution Control Board-central and state pollution control boards.

HUMAN POPULATION AND ENVIRONMENT **9 hrs**

Population – Population growth & Population Explosion –Family welfare programme - Environment & human health - Human rights – Value education –AIDS/HIV, Role of information technology in environment and human health.

TEXT BOOK

1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.
2. Erach Bharucha "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India
3. Benny Joseph “Environmental Science and Engineering”, Tata Mc Graw- Hill, New Delhi

REFERENCES:

1.Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.

2. Anubha Kaushik and C.P Kaushik “Perspectives of Environmental Studies”, New age international publishers.

3. Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviromedia.

4. Environmental Science and Engineering by Dr. J. Meenambal, MJP Publication, Chennai Gilbert M. Masters: Introduction to Environmental Engineering and Science , Pearson EducationPvtLtd., II Edition, ISBN 81-297-0277-

0,2004.
5. Miller T.G.Jr. Environmental Science Wads worth Publishing. Co.
6. Townsend C. Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science.

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1	Dr. R.Nagalakshmi	nagalakshmi.chemistry@avit.ac.in
2	A. Gilbert Sunderraj	gilbertsunderraj@vmkvec.edu.in

ENGINEERING SCIENCES COURSES

35021E01	FOUNDATIONS OF COMPUTING AND PROGRAMMING (Theory and Practicals)	Category	L	T	P	Credit
		FC-ES	2	0	2	3

PREAMBLE

This course aims to provide the fundamental concepts of Computer operations like hardware and software installation, and emphasizing principles programming languages. Studying the fundamentals database languages, commands and internet basics.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To provide basic knowledge of hardware components of computers and classifications.
2	To introduce and demonstrate various Operating System functions and software. Software application packages.
3	To study Principles of programming and applications of programming.
4	To learn about various Database Management Systems languages and commands used.
5	To learn basics of Internet and Web services.

COURSE OUTCOMES

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

CO1. To understand the Basic knowledge on computer hardware and its functions.	Understand
CO2. To get knowledge of Fundamentals of various Operating System functions and soft wares.	Understand
CO3.To Understand the principles of programming and categories of programming languages.	Apply
CO4.To demonstrates Database Management Systems languages and their classifications.	Apply
CO5.To understands and demonstrates the Internet Basics.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	S	M	-
CO2	S	M	M	-	M	-	-	-	-	-	-	M	S	M	M
CO3	S	S	S	-	M	-	-	-	-	-	-	-	S	-	M
CO4	S	S	S	-	S	-	-	-	-	-	-	-	S	M	M
CO5	S	M	M	-	M	-	-	-	-	-	-	S	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction to computers:

Characteristics of computers, Classification of Digital Computer Systems: Microcomputers, Minicomputers, Mainframes, Supercomputers. Anatomy of Computer: Introduction, Functions & Components of a Computer, Central Processing Unit, Microprocessor, Storage units, Input and output Devices. How CPU and memory works. Program execution with illustrative examples.
Lab Component- PC Assembly,

Operating System Fundamentals:

Operating Systems: Introduction, Functions of an operating System, Classification of Operating Systems, System programs, Application programs, Utilities, The Unix Operating System, Basic Unix commands, Booting,
Lab Component-, Basic unix commands

Introduction to Principles of programming

Introduction to Programming, Programming Domain: Scientific Application, Business Applications, Artificial Intelligence, Systems Programming, Web Software
Categories of Programming Languages: Machine Level Languages, Assembly Level Languages, High Level Languages, Problem solving using Algorithms and Flowcharts

Introduction to Database Management Systems

Database, DBMS, Why Database -File system vs DBMS, Database applications, Database users, Introduction to SQL, Data types, Classification of SQL-DDL with constraints, DML, DCL, TCL
Lab Component
Create: Table and column level constraints- Primary key, Foreign key, Null/ Not null, Unique, Default. Check, Alter, Drop, Insert, Update, Delete, Truncate, Select: using WHERE, AND, OR, IN, NOT IN

Internet Basics

Introduction, Features of Internet, Internet application, Services of Internet, Internet Service Providers, and Domain Name System.
Web Basics Introduction to web, web browsers, http/https, URL, HTML, CSS

Lab Component -HTML & CSS, web Browsing, Emails, Searching

TEXT BOOKS:

1. J. Glenn Brookshear, "Computer Science: An Overview", Addision-Wesley, Twelfth Edition, 2014REFERENCES:
1. "Concepts of programming language" Concepts of Programming Languages Eleventh Edition GLOBAL Edition Robert W. Sebesta.
Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd Edition, Addison Wesley, 1997.
2. Knuth D.E., "The Art of computer programming Vol 1: Fundamental Algorithms", 3rd Edition, Addison Wesley, 1997.

COURSE DESIGNERS

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	BASICS OF CIVIL AND MECHANICAL ENGINEERING PART-A BASICS OF CIVIL ENGINEERING	Category	L	T	P	Credit
34421E01	(Common to All Branches)	FC-ES	2	0	0	2

PREAMBLE

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering.

PREREQUISITE-NIL

COURSE OBJECTIVES

1	To understand the basic concepts of surveying and apply in practical problems
2	To study in detail different types of construction materials.
3	To impart basic knowledge about building components.

COURSE OUTCOMES

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

CO1.An ability to apply concepts of Surveying on practical applications.	Apply
CO2. Explain different types of buildings, building components, building materials and building construction.	Remember
CO3.Expalin the essentials of components of a building and application of load on it	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
CO1	L	M	-	S	L	-	M	M	L	L	-	L	M	M	M
CO2	S	M	L	-	M	S	-	-	-	-	-	-	M	-	-
CO3	S	M	L	S	M	S	-	-	M	-	-	-	-	S	-

S-Strong; M-Medium; L-Low

SYLLABUS

SURVEYING

Objects–types–classification–principles–measurements of distances–angles–levelling–determination of areas– illustrative examples.

CIVIL ENGINEERING MATERIALS

Bricks –stones–sand –cement –concrete mix design and Quantity computation–steel sections.

BUILDING COMPONENTS AND STRUCTURES:

FOUNDATIONS: Types, Safe Bearing capacity of Soil –Requirement of good foundations.

SUPERSTRUCTURE: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces –Load Transformation Mechanism in Structural Elements– stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping– water supply – sources and quality of water — Rain water harvesting — introduction to high way and rail way.

TEXTBOOKS:

1. BasicCivil and Mechanical Engineering, VMU, (2017). Company Ltd., New Delhi,2009.
2. Basic Civil and Mechanical Engineering, M.Prabakaran, S.P.Sangeetha, Vemuri Lakshminarayana, Maruthi Publishers, 2017.
3. Reinforced Concrete Structures‖ B.C. Punmia, Vol. 1 & 2, - Laxmi Publications, Delhi, 2004.

REFERENCES:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpatrai Publishing Co. (P) Ltd., 2009.
2. Rangwala S.C and Dalal K.B, Building Construction, Charotar Publishing house, 2022.

COURSE DESIGNERS

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34421E01	B.BASICS OF MECHANICAL ENGINEERING	Category	L	T	P	Credit
		FC -ES	2	0	0	2

Preamble

This course provides a preliminary knowledge of the applications of mechanical engineering in our day to day life.

Prerequisite-NIL

Course Objectives

1	To demonstrate the principles of casting and metal joining processes in manufacturing.
2	Understand the importance and uses of IC Engines, working principles of IC Engines.
3	Comprehend the working and use of various power plants.

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

CO1.	Illustrate the application of casting and metal joining processes in manufacturing	Apply
CO2.	Demonstrate the operation of automotive engines and important components	Apply
CO3.	Understanding the construction and the working principle of conventional and non-conventional power generation	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	L	M	-	-	-	-	-	-	-	-	-	-
CO2	S	M	M	L	L	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	L	L	-	-	-	-	-	-	-	-	-	-

S-Strong; M-Medium; L-Low

SYLLABUS

BASIC MANUFACTURING PROCESSES

Casting process-Introduction, Principle, Advantages, casting defects Forging process-introduction, forging, rolling, drawing, extrusion Welding process- introduction, principle, types-Gas and arc welding

IC ENGINES

The Importance and uses of Engines-Definition, Classification-I C & E C Engines- two stroke engines - four stroke engines - various parts and functions of I C engines-working of two stroke petrol engine and diesel engine with line sketches - working of four stroke petrol and diesel engines with line sketches - Comparison between two stroke and four stroke engines -S I and C I engines.

POWER PLANT ENGINEERING

Classification of power plants- Working of power plant with line Sketches-Steam power plant-Hydro- electric power plant - Diesel power plant -Nuclear power plant- merits and demerits. Nonconventional energy power plants – solar- wind-tidal- geo thermal, with line sketches- merits & demerits of various non conventional power plants

Text Books

1	Power plant Engineering, by G.R Nagpal
2	Internal combustion Engines by Ganesan
3	Workshop technology vol1, by S K Hajra Choudhury

Reference Books

1	Production technology, by P.C Sharma
2	Thermal Engineering, by R.S.Khurumi
3	Power plant Engineering, by R.K Bansal

Course Designers

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	PYTHON PROGRAMMING	**CATEGORY**	**L**	**T**	**P**	**CREDIT**
35021E02	**(Theory and Practicals)**	**FC-ES**	**2**	**0**	**2**	**3**

PREAMBLE

The purpose of this course is to introduce Python, a remarkably powerful dynamic programming language to write code for different operating systems along with application domain. Python has evolved on more popular and powerful open source programming tool

PRERQUISITE

NIL

COURSE OBJECTIVES

1	To provide basic knowledge on Python programming concepts.
2	To introduce different methods in list, string, tuple, dictionary and sets.
3	To compute different programs using python control statements.
4	To learn about different functions in python.
5	To compute the exception handling functions, file concepts and CSV and JSON.

COURSE OUTCOMES

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

CO1. Learn python statements, comments and indentation, tokens, input and output methods using various example programs.	Understand
CO2. Apply the different methods involved in List, String, Tuples and Dictionary.	Apply
CO3. Design solutions for complex programs using decision making and looping statements.	Apply
CO4.Apply the function programs with all the concepts like lambda, decorators and generators.	Apply
CO5. Compute the exception handling programs, file concept programs and understand the concepts of CSV and JSON.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO2	S	M	M	M	M	-	-	-	-	-	-	-	S	M	M
CO3	M	S	S	S	M	-	-	-	-	-	-	-	M	M	M
CO4	S	S	S	S	M	-	-	-	-	-	-	-	S	S	M
CO5	S	M	M	M	M	-	-	-	-	-	-	-	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

1 INTRODUCTION

Introduction to python-Advantages of python programming-Tokens-Variables-Input/output methods-Data types-Operators

2 DATA STRUCTURES

Strings-Lists-Tuples-Dictionaries-Sets

3 CONTROL STATEMENTS

Flow Control-Selection control Structure-if-if-else-if-else-if-else-Nested if iterative control structures-while loop, for loop and range.

4 FUNCTIONS

Declaration-Types of Arguments-Fixed arguments, variable arguments, keyword arguments and keyword variable arguments-Recursions-Anonymous functions: lambda- Decorators and Generators.

5 EXCEPTION HANDLING

Exception Handling-Regular Expression-Calendars and clock files: File input/output operations-Dictionary operations-Reading and writing in structured files: CSV and JSON.

LIST OF EXPERIMENTS

1. Write a program to sum of series of N natural numbers
2. Write a program to calculate simple interest.
3. Write a program to generate Fibonacci series using for loop
4. Write a program to calculate factorial using while loop
5. Write a program to find the greatest of three numbers using if condition
6. Write a program for finding the roots of a given quadratic equation using conditional control statements
7. Write a program to find the greatest of three numbers using conditional operator
8. Write a program to compute matrix multiplication using the concept of arrays
9. Write a program to implement recursive function
10. Write a program to read and write data using file concepts

TEXT BOOKS:

1. Bill Lubanovic, "Introducing Python Modern Computing in Simple Packages", 1st Edition, O'Reilly Media, 2014.
2. Programming With Python Book „Himalaya Publishing House Pvt Ltd
3. "Dive Into Python" by Mark Pilgrim

REFERENCES:

1. Mark Lutz, "Learning Python", 6th Edition, O'Reilly Media, 2014.
2. David Beazley, Brian K. Jones, "Python Cookbook", 3rd Edition, O'Reilly Media, 2015.
3. Mark Lutz, "Python Pocket Reference", 6th Edition, O'Reilly Media, 2015.

COURSE DESIGNERS				
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	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	**Category**	**L**	**T**	**P**	**Credit**
34621E01	**A. BASICS OF ELECTRICAL ENGINEERING**	**FC-ES**	**2**	**0**	**0**	**2**

PREAMBLE

It is a preliminary course which highlights the basic concepts and outline of Electrical engineering. The concepts discussed herein are projected to deliver explanation on basic electrical engineering for beginners of allengineering graduates.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To explain the basic laws used in Electrical circuits and various types of measuring instruments.
2	To explain the different components and function of electrical dc and ac machines.
3	To understand the fundamentals of safety procedures, Earthing and Power system.

COURSE OUTCOMES

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

CO1: Explain the electrical quantities and basic laws of electrical engineering.	Remember
CO2: Demonstrate Ohm's and Faraday's Law.	Apply
CO3: Describe the basic concepts of measuring instruments.	Understand
CO4: Explain the operation of electrical machineries and its applications.	Understand
CO5: Explain the electrical safety and protective devices.	Understand
CO6: Compare the various types electrical power generation systems by application of conventional and non-conventional sources.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	-	-	M	L	-	-	-	L	M	L	S	M	L
CO2	S	M	M	L	M	-	-	-	S	M	M	L	S	L	-
CO3	S	M	M	M	M	-	-	-	-	L	M	L	S	M	L
CO4	S	M	L	L	M	L	-	-	-	L	M	L	S	L	-
CO5	S	M	L	-	M	S	-	-	-	L	L	L	-	-	-
CO6	S	M	-	-	M	L	S	L	-	L	L	L	M	L	M

S- Strong; M-Medium; L-Low

SYLLABUS
ELECTRICAL CIRCUITS AND MEASUREMENTS

Electrical quantities - Charge, Electric potential, current, power and Energy, Passive components (RLC)- Fundamental laws of electric circuits-steady solution of DC circuits - Introduction to AC circuits- Sinusoidal steady state analysis -Power and Power factor – Single phase and Three phase balanced circuits - Classification of Instruments-Operating Principles of indicating instruments.

ELECTRICAL MACHINES

Faraday's Law, Construction, Principle of operation, Basic Equation and Applications of DC & AC Generators and Motors - Single Phase Transformer, Single phase and Three phase Induction Motor.

ELECTRICAL SAFETY AND INTRODUCTION TO POWER SYSTEM

Protection & Safety - Hazards of electricity - shock, burns, arc-blast, Thermal Radiation, explosions, fires, effects of electricity on the human body. Electrical safety practices, Protection devices.

Types of Generating stations, Transmission types & Distribution system (levels of voltage and power ratings)- Simple layout of generation, transmission and distribution of power.

TEXT BOOKS:

1. Metha.V.K, Rohit Metha, "Basic Electrical Engineering", Fifth Edition, Chand. S&Co, 2012.
2. Kothari.D.P and Nagrath.I. J, "Basic Electrical Engineering", Second Edition, Tata McGraw-Hill, 2009.
3. R.K.Rajput , "Basic Electrical and Electronics Engineering", Second Edition, Laxmi Publication, 2012.

REFERENCE BOOKS:

1. Smarajt Ghosh, "Fundamentals of Electrical & Electronics Engineering", Second Edition, PHI Learning, 2007.

COURSE DESIGNERS

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4	Mr. S. Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	Category	L	T	P	Credit
34621E01	B. BASICS OF ELECTRONICS ENGINEERING	FC-ES	2	0	0	2

PREAMBLE

The course aims to impart fundamental knowledge on electronics components, digital logics and communication engineering concepts. The course begins with classification of various active and passive components, diodes and transistors. It enables the student to design small digital logics like multiplexer, de-multiplexer, encoder, decoder circuits, etc. It crafts the students to get expertise in modern communication systems.

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To learn and identify various active and passive components and their working principles.
2	To understand the number conversion systems and working Principles of logic gates.
3	To learn the digital logic principles and realize adders, multiplexer, etc.,
4	To understand the application-oriented concepts in the Various communication systems.

COURSE OUTCOMES

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

CO1. Interpret working principle and application of various active and passive electronic components like resistors, capacitors, inductors, diodes and transistors.	Understand
CO2. Construct the rectifier, Clipper, Clamper, regulator circuits and explore their operations.	Apply
CO3. Execute number system conversions and compute several digital logic operations.	Apply
CO4. Design adders, Multiplexer, De-Multiplexer, Encoder, Decoder circuits for given data input.	Apply
CO5. Expose the working principles of modern technologies in developing application-oriented gadgets like the UHD, OLED, HDR and various communication systems.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	L	-	-	-	M	-	-
CO2	S	M	M	M	-	-	M	-	L	-	-	L	-	M	-
CO3	S	M	M	-	-	-	-	-	L	-	-	-	S	-	-
CO4	S	M	M	M	-	-	M	-	L	-	-	L	M	-	-
CO5	S	M	-	-	-	-	-	-	L	L	-	L	S	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

SEMICONDUCTOR DEVICES

Passive and Active Components - Resistors, Inductors, Capacitors- Intrinsic Semiconductor, Extrinsic Semiconductor, Energy band diagram- Conductor, insulator, semiconductor, Characteristics of PN Junction Diode - Zener Diode and its Characteristics - Half wave and Full wave Rectifiers, Voltage Regulation- Simple wave shaping circuits- Clipper, Clamper.Bipolar Junction Transistor, JFET, MOSFET & UJT.

DIGITAL FUNDAMENTALS

Number Systems – Binary, Octal, Decimal and Hexa-Decimal – Gray Code- Conversion from one to another – Logic Gates and its characteristics – AND, OR, NOT, XOR, Universal Gates – Adders, Multiplexer, De Multiplexer, Encoder, Decoder – Memories.

COMMUNICATION AND ADVANCED GADGETS

Modulation and Demodulation – AM, FM, PM, PCM, DM– RADAR – Satellite Communication – Mobile Communication, Optical communication, Microwave communication. LED, HD, UHD, OLED, HDR & Beyond, SmartPhones – Block diagrams Only.

TEXT BOOKS:

1. R.K. Rajput, "Basic Electrical and Electronics Engineering", Laxmi Publications, Second Edition, 2012.
2. Dr.P. Selvam, Dr.R.Devarajan, Dr.A.Nagappan, Dr.T. Muthumanickam and Dr.T.Sheela,"Basic Electrical and Electronics Engineering", Department of EEE & ECE, Faculty of Engineering & Technology, VMRFDU, Anuradha Agencies, 2018.
3. Edward Hughes, "Electrical and Electronics Technology", Pearson Education Limited, Ninth Edition, 2005.

REFERENCES:

1. John Kennedy, "Electronics Communication System", Tata McGraw Hill, 2003.

COURSE DESIGNERS

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		Category	L	T	P	Credit
34421E83	**WORKSHOP PRACTICES**	**FC-ES**	**0**	**0**	**4**	**2**

Preamble

Workshop practices is fundamental to the development of any engineering product. This course is intended to expose engineering students to different types of manufacturing/ fabrication processes. It deals with machine, fitting, carpentry, foundry, smithy and welding related exercises. Also, it will induce the habit of selecting right tools, planning the job and its execution.

Prerequisite –NIL

Course Objectives

1	Exposure to the students with hands on experience on various basic engineering practices in Engineering.
2	To have a study and hands-on-exercise on plumbing and carpentry components.
3	To have a practice on gas welding, foundry operations and fitting.

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

CO1.	Upon completion of this laboratory course, students will be able to fabricate components with their own hands.	Apply
CO2.	Examine the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	Apply
CO3.	Assembling different components, they will be able to produce small devices of their interest.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	S	M	L	L	L	-	-	-	-	-	-	-	L	-	-
CO2	S	M	L	L	L	-	-	-	-	-	-	-	L	-	-
CO3	S	M	L	L	L	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

Course Contents

1. Manufacturing Methods - machining and joining methods.
2. Fitting operations
3. Carpentry.
4. Casting.
5. Tin Smithy

Lectures & videos

Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
Fitting operations & power tools
Carpentry
Metal casting
Welding (arc welding & gas welding)

Workshop Practices

1. Facing, Turning, Step Turning, Drilling, Surface finish –Machine Shop
2. L and V Fitting - Fitting Shop
3. Single piece and Split piece pattern - Foundry
4. Half- Lap Joint and Dove Tail Joint - Carpentry
5. Lap Joint, Butt Joint and T Joint – Welding
6. Open Scoop, Rectangle Tray – Tin Smithy

Text Books		
1	**WORKSHOP/MANUFACTURING PRACTICES, MANUAL**	
Reference Books		
1	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I and Vol. II , Media promoters and publishers private limited, Mumbai	
2	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House.	
3	NR. Banapurmath, Basic Mechanical Engineering, Vikas Publications, Noida.	
4	K.Venugopal, Basic Mechanical Engineering, Anuradha Publications, Chennai.	
Experiments be performed through Virtual Labs		
1	Welding shop	http://mmcoep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Microma chining%20laboratory
2	Casting	http://fabcoep.vlabs.ac.in/exp7/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20FAB%20laboratory

Course Designers

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		Category	L	T	P	Credit
35021E03	**PROGRAMMING FOR PROBLEM SOLVING**	**FC-ES**	**3**	**0**	**0**	**3**

PREAMBLE

The course is designed to introduce basic problem solving and program design skills that are used to create computer programs. It gives engineering students an introduction to programming and developing analytical skills to use in their subsequent course work and professional development. This course focuses on problem solving, algorithm development, top- down design, modular programming, debugging and testing using the programming constructs like flow-control, looping, iteration and recursion. It presents several techniques using computers to solve problems, including the use of program design strategies and tools, common algorithms used in computer program and elementary programming techniques.

PREREQUISITE–NIL

COURSE OBJECTIVES

1.	To gain basic knowledge about simple algorithms for arithmetic and logical problems.
2.	To learn how to write a program, syntax and logical errors.
3.	To understand how to decompose a problem into functions and synthesize a complete program.

COURSE OUTCOMES

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

CO1: Formulate simple algorithms for arithmetic and logical problems.	Understand
CO2: Test and execute the programs and correct syntax and logical errors	Apply
CO3: Implement conditional branching, iteration and recursion.	Apply
CO4: Decompose a problem into functions and synthesize a complete program.	Analze
CO5: Use arrays, pointers, strings and structures to formulate algorithms and programs	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	-	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M	M	S

S-Strong; M-Medium; L-Low

SYLLABUS

UNIT – I: INTRODUCTION

Computer system: components of a computer system-computing environments-computer languages, creating and running programs, Algorithms, flowcharts- Introduction to C language: basic structure of programs, process of compiling and running program, -tokens, keywords, identifiers, constants, strings, special symbols, variables, data types-I/O statements

UNIT – II: OPERATORS, EXPRESSIONS AND CONTROL STRUCTURES

Operators and expressions: Operators- arithmetic- relational and logical- assignment operators- increment and decrement operators, bitwise and conditional operators-special operators- operator precedence and associativity- evaluation of expressions-type conversions in expressions- Control structures: Decision statements: if and switch statement- Loop control statements: while, for and do while loops- jump statements- break-continue-goto statements.

UNIT – III: ARRAYS AND FUNCTIONS

Arrays: One dimensional array-declaration and initialization of one dimensional arrays- two dimensional arrays-initialization and accessing- multidimensional arrays- Basic Algorithms: Searching- Basic Sorting Algorithms-Functions: User defined and built-in Functions- Parameter passing in functions-call by value -Passing arrays to functions-call by reference, Recursion-Example programs, such as Finding Factorial, Fibonacci series

UNIT – IV: STRINGS AND POINTERS

Strings: Arrays of characters- variable length character strings-inputting character strings-character library functions-string handling functions- Pointers: Pointer basics- pointer arithmetic-pointers to pointers-generic pointers-array of Pointers- functions returning pointers -Dynamic memory allocation

UNIT – V: STRUCTURES AND FILE HANDLING

Structures and unions: Structure definition- initialization- accessing structures-nested structures arrays of structures-structures and functions- unions- typedef- enumerations -File handling: command line arguments- File modes- basic file operations read, -write and append

TEXTBOOKS

1. Schaum's Outline of Programming with C by Byron Gottfried, McGraw-Hill

REFERENCES

1. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
2. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.

Course Designers:

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2	Mr.B.Sundaramurthy	Assistant Professor	CSE	sundaramurthy@vmkvec.edu.in

	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB	**Category**	**L**	**T**	**P**	**Credit**
34621E81	**A. BASICS OF ELECTRICAL ENGINEERING**	**FC-ES**	**0**	**0**	**2**	**1**

PREAMBLE

It is a laboratory course which familiarizes the basic electrical wiring, measurement of electrical quantities and various types of earthing methods.

PRERQUISITE – NIL

COURSE OBJECTIVES

1	To learn the residential wiring and various types of electrical wiring.
2	To measure the various electrical quantities.
3	To know the necessity and types of earthing and measurement of earth resistance.

COURSE OUTCOMES

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

CO1: Implement the various types of electrical wiring.	Apply
CO2: Measure the fundamental parameters of AC circuits.	Analyze
CO3: Measure the earth resistance of various electrical machineries.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	--	S	--	--	--	--	--	--	L	M	L	--
CO2	S	M	S	S	--	--	--	--	M	--	--	M	M	L	--
CO3	L	S	L	--	S	--	--	--	--	L	--	L	M	L	--

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Types of wiring, Joints and Measurement of resistance to earth of an electrical equipment.

REFERENCES

1. Laboratory Reference Manual.

COURSE DESIGNERS

S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr. R. Devarajan	Professor	EEE/VMKVEC	devarajan@vmkvec.edu.in
2	Dr. G. Ramakrishnaprabu	Associate Professor	EEE/VMKVEC	ramakrishnaprabu@vmkvec.edu.in
3	Ms. D. Saranya	Assistant Professor (Gr-II)	EEE/AVIT	dsaranya@avit.ac.in
4	Mr. S. Prakash	Assistant Professor (Gr-II)	EEE/AVIT	sprakash@avit.ac.in

		Category	L	T	P	Credit
34621E81	PART B – BASICS OF ELECTRONICS ENGINEERING	FC-ES	0	0	2	1

PREAMBLE

This course is to provide a practical knowledge in Basic Electronics Engineering. It starts with familiarization of electronic components and electronic equipments. It enables the students to construct and test simple electronic projects

PRERQUISITE – Nil

COURSE OBJECTIVES

1	To familiarize the electronic components, basic electronic equipments and soldering techniques.
2	To study the characteristics of Diodes, BJT and FET.
3	To understand the principles of various digital logic gates.
4	To understand the concept of basic modulation techniques.

COURSE OUTCOMES

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

CO1. Familiarize with the fundamentals of soldering techniques.	Understand
CO2. Construct experiments for PN and Zener diode characteristics also determine diode forward and reverse resistance	Apply
CO3. Construct clipper and clamper circuit and verify their voltage levels	Apply
CO4. Construct and justify operation simple voltage regulator for given Zener diode	Apply
CO5. Verify the truth tables and characteristics of logic gates (AND, OR, NOT, NAND, NOR, XOR).	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	--	-	L	-	-	-	M	-	-
CO2	S	M	M	M	-	-	M	-	L	-	-	L	-	M	-
CO3	S	M	M	-	-	-	--	-	L	-	-	-	S	-	-
CO4	S	M	M	M	-	-	M	-	L	-	-	L	M	-	-
CO5	S	M	-	-	-	-	-	-	L	L	-	L	S	-	L

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Practicing of Soldering and Desoldering.
2. Characteristics of PN junction Diode and find the forward and reverse resistance
3. Construct and Study simple clipper and clamper circuits

4. Characteristics of Zener diode and determine the break down voltage and diode resistance5.Construct and Study simple voltage regulator using zener diode
6. Verification of Logic Gates.
7. Find the characteristics of AND, NOR, NOT gate
8. Construct and Study simple voltage regulator using zener diode.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.T.Sheela	Associate Professor	ECE	sheela@vmkvec.edu.in
2	Mr.S.Selvaraju	Associate Professor	ECE	selvaraju@vmkvec.edu.in
3	Mr.R.Karthikeyan	Assistant Professor (Gr-II)	ECE	rrmdkarthikeyan@avit.ac.in
4	Ms.R.Mohana Priya	Assistant Professor (Gr-II)	ECE	mohanapriya@avit.ac.in

34421E81	ENGINEERING GRAPHICS AND DESIGN	Category	L	T	P	Credit
		FC-ES	0	0	6	3

Preamble

Engineering Graphics is referred as language of engineers. An engineer needs to understand the physical geometry of any object through its orthographic or pictorial projections. The knowledge on engineering graphics is essential in proposing new product through drawings and interpreting data from existing drawings. This course deals with orthographic and pictorial projections, sectional views and development of surfaces.

Prerequisite

NIL

Course Objectives

1	To implement the orthographic projections of points, straight lines, plane surfaces and solids.
2	To construct the orthographic projections of sectioned solids and true shape of the sections.
3	To develop lateral surfaces of the uncut and cut solids.
4	To draw the pictorial projections (isometric and perspective) of simple solids.
5	To draw the orthographic views from the given pictorial view.

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

CO1.	Execute in the form of drawing of the orthographic projections of points, straight lines, plane surfaces and solids.	Apply
CO2.	Demonstrate in the form of drawing of the orthographic projections of sectioned solids and true shape of the sections.	Apply
CO3.	Develop lateral surfaces of the solid section and cut section of solids.	Apply
CO4.	Draw the pictorial projections (isometric and perspective) of simple solids.	Apply
CO5.	Draw the orthographic views from the given pictorial view.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO2	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO3	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-
CO4	S	M	L	S	S	-	-	-	-	-	-	-	L	-	-
CO5	S	S	L	S	L	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

PLANE CURVES AND DIMENSIONING

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Dimensioning. Projection of points.

PROJECTION OF SOLIDS

Projection of lines, Projection of simple solids like prisms, pyramids, cylinder and cone when the axisis inclined to any one reference plane by change of position method.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position by cutting planes inclined to any one referenceplane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids like Prisms, pyramids, cylinders and cones.

ORTHOGRAPHIC VIEWS AND ISOMETRIC VIEWS – First angle projection – layout views – Representation of Three Dimensional objects -multiple views from pictorial views of objects.

Principles of isometric View – isometric scale – Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones.

INTRODUCTION TO AUTO CAD

Introduction to Auto CAD- Basic introduction and operational instructions of various commands in AutoCAD. Limit System- Tolerance, Limits, Deviation, Actual Deviation, Upper Deviation, Lower

Deviation, Allowance. Preparation of manual parts drawing and assembled sectional views from orthographic part drawings,	
Text Books	
1	Natarajan K V, “Engineering Graphics”, Tata McGraw-Hill Publishing Company Ltd. New Delhi.
2	K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Private Limited.
3	K.R.Gopalakrishna“Engineering Drawing” (Vol. I & II), Subhas Publications, 2014.
4	Bhatt-N.D.-"Machine Drawing"-Published by R.C.Patel- Chartstar Book Stall- Anand-India- 2003
Reference Books	
1	N.D. Bhat and V.M. Panchal, Engineering Graphics, Charotar Publishers 2013
2	E. Finkelstein, “AutoCAD 2007 Bible”, Wiley Publishing Inc., 2007
3	R.K. Dhawan, “A text book of Engineering Drawing”, S. Chand Publishers, Delhi,2010.
4	DhananjayA.Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.
5	G.S. Phull and H.S.Sandhu, “Engineering Graphics”, Wiley Publications, 2014.

Course Designers

S.No	Faculty Name	Designation	Dept / College	Email id
1	Dr. S.Venkatesan	Professor	Mech / VMKVEC	venkatesan@vmkvec.edu.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in
3	Mr.A.Imthiyas	Assistant Professor	Mech/AVIT	imthiyas@avit.ac.in

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute	Duriation
1.	Engineering Graphics and Design	Prof. Naresh Varma Datla, Prof. S. R. Kale	IIT Delhi	12 weeks
2.	Engineering Drawing	Robi, P.S.	IIT Guwahati	12 weeks
3.	Engineering Drawing and Computer Graphics	Prof. Rajaram Lakkaraju	IIT Kharagpur	12 weeks

34421E02	ENGINEERING MECHANICS	Category	L	T	P	Credit
		FC-ES	2	1	0	3

Preamble

This course provides the basic knowledge about the behavior of the bodies which are under staticand dynamic conditions.

Prerequisite

NIL

Course Objectives

1	To explain the basic laws of mechanics and forces
2	To relate the basic concepts and application of rigid bodies under equilibrium in two dimension
3	To employ the concepts of properties of surfaces and to find the Centroid and moment of Inertia using various methods in solid sections.
4	To practice problems in the areas of Friction and Rigid body dynamics by understanding the basic concepts of Friction and Rigid body dynamics.
5	To calculate and categorize of problems in the area of dynamics of particles.

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

CO1.	Identify the engineering problems using the concept of static equilibrium	Understand
CO2.	Solve problems of rigid bodies under equilibrium in two dimension and apply various conditions	Apply
CO3.	Determine the Centroid of a line, areas, and volumes, center of mass of body and moment of inertia of composite areas, mass moment of inertia	Apply
CO4.	Solve problems involving frictional phenomena.	Apply
CO5.	Solve problems in engineering systems using the concept of dynamic equilibrium and analyze the numerical results	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	-	L	-	-	-	-	-	-	L	-	-
CO2	S	L	L	M	-	L	-	-	-	-	-	-	L	-	-
CO3	S	M	M	M	-	L	-	-	-	-	-	-	M	-	-
CO4	S	M	M	M	-	L	-	-	-	-	-	-	M	-	-
CO5	S	S	S	S	-	L	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS & STATICS OF PARTICLES

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem. Parallelogram and triangular law of forces – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

EQUILIBRIUM OF RIGID BODIES

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimension.

PROPERTIES OF SURFACES AND SOLIDS

Determination of Areas and Volumes – First moment of area the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principle moments of inertia of plane areas – Mass moment of inertia.

FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction. Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

DYNAMICS OF PARTICLES

Displacement, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy equation of particles – Impulse and Momentum – Impact of elastic bodies.

Text Books

1	Beer & Johnson, Vector Mechanics for Engineers. Vol. I Statics and Vol. II Dynamics, McGraw Hill International Edition, 1995.
2	Kottiswaran N,Engineering Mechanics-Statics & Dynamics,Sri Balaji Publications,2014.
3	Meriam, Engineering Mechanics, Vol. I Statics & Vol. II Dynamics 2/e, Wiley Intl., 1998.

Reference Books

1	Rajasekaran.S, and Sankara Subramanian G, "Engineering Mechanics", Vikas Publishing Co. New Delhi.
2	Irving H. Sharma, Engineering Mechanics – Statics & Dynamics, III Edition, Prentice Hall of India Pvt. Ltd., 1993.
3	K.L.Kumar, Engineering Mechanics III Edition, Tata McGraw Hill Publishing Co. Ltd., 1998

Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	J.Sathees Babu	Associate Professor	Mech / VMKVEC	satheesbabu@vmkvec.edu.in
2	Dr.S.Arunkumar	Associate Professor	Mech / VMKVEC	arunkumar@vmkvec.edu.in
3	Dr.S.Sangeetha	Associate Professor	Mech/AVIT	sangeethas@avit.ac.in

PROGRAM CORE COURSES

	MANUFACTURING PROCESSES	**Category**	**L**	**T**	**P**	**Credit**
34421C02	**(Theory and Practicals)**	**CC**	**3**	**0**	**2**	**4**

Preamble

This course provides an introduction to Basic Manufacturing Process with a focus casting, welding, forming process, Sheet metal working and plastic Engineering and also provides knowledge on the working, advantages, limitations and applications of various machining processes. Machine tools are power driven machine for making products of a given shape, size and accuracy by removing metal from the metal block

Prerequisite : NIL

Course Objectives

1	To understand the manufacturing process of conventional and special casting process of foundry technology
2	To impart the knowledge of various types welding process in metal joining processes.
3	To apply fundamentals of metal cutting processes and cutting tools.
4	To apply the knowledge of different operations on special machines and various types of work holding devices
5	To impart the knowledge of various metal unconventional, conventional machining operations and also metal forming processes.

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

CO1.	Explain the working principles of various metal casting processes and to identify the defects and interpret causes in the product of metal casting processes.	Understand
CO2.	Discuss the working principles of various metal joining processes and machines/equipments used and Select the suitable joining methods for fabrication/ assembly of products.	Understand
CO3.	Understand the chip formation for different cutting forces and cutting tool life.	Understand
CO4.	Understand the working principle and operations of Shaper, Milling, Drilling and boring Machines	Understand
CO5.	Understand the working principle of various metal forming processes and basics of additive manufacturing technology	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**
CO2	**S**	**M**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**
CO3	**S**	**M**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**-**	**-**
CO4	**S**	**L**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**-**	**-**
CO5	**S**	**L**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MANUFACTURING & CASTING

Introduction-Role of Manufacturing in the development of a country - classification of manufacturing processes-Fundamentals of metal casting – Types of patterns – sand mold making –different casting techniques – types of furnaces – Defects in castings – Testing and inspection of castings.

JOINING PROCESSES

Classification of welding processes - Principles of Oxy-acetylene gas welding-A.C metal arc welding- Resistance welding- Submerged arc welding- tungsten inert gas welding- metal inert gas welding- plasma arc welding- thermit welding- electron beam welding- laser beam welding, and identify defects in welding process - Soldering and brazing.

FUNDAMENTALS OF METAL CUTTING & CUTTING TOOLS

Basics of metal cutting: Mechanism of chip formation (orthogonal and oblique cutting)-Chip thickness ratio-Velocity ratio-Merchant circle diagram- Types of chips- Basics of cutting tools: Characteristics, Cutting tool materials, properties and applications -Tool life: Taylor's equation-Variables affecting tool life and Tool wear. Tool wear and Causes.

MACHINING PROCESSES

Introduction, Classification, working principle, operations performed: Lathe, Shaper, Planner, Horizontal milling machine, Universal drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. Super finishing processes: Lapping, Honing, Super finishing, Polishing & Buffing.

METAL FORMING PROCESSES & ADVANCED MANUFACTURING TECHNOLOGY

Cold and hot working of metals – Bulk metal forming- Sheet metal forming- High Energy Rate Forming processes: Explosive forming- Electro hydraulic forming – Electromagnetic forming. Need and Classification of Additive Manufacturing Technology - Product development and Materials for Additive Manufacturing Technology – Tooling - Applications.

LIST OF EXPERIMENTS

1. Greens and moulding process using split pattern.
2. Joining of two metal pieces by electric arc welding.
3. Make an external thread cutting operation by using centre lathe.
4. Make a square end from a given round bar by using shaping machine.
5. Make a hexagonal block from a given round stock by using plain milling machine.
6. Make a spur gear from the given blank by using universal milling machine.
7. Make an external keyway on a given round rod by using vertical milling machine.
8. Make an internal keyway on a given hallow specimen by using slotting machine.
9. Make a grinding process on a machined surface as given surface finish by using cylindrical grinding machine.
10. Make an internal thread cutting on a given specimen as per given dimensions by the sequence drilling, boring, reaming and tapping by using respective tools and machines.

Text Books

1. Fundamental of Modern Manufacturing: Mikell P.Groover
2. A Text Book of Production Technology (Manufacturing Processes) : S. Chand.

Reference Books

1. SeropeKalpajian, Steven R.Schmid, “Manufacturing Processes for Engineering Materials”, 4/e, Pearson Education, Inc. 2007.
2. Jain. R.K.,and S.C. Gupta, “Production Technology”, 16th Edition, Khanna Publishers, 2001
3. E.Paul Degarmo, J.T.Black, and Ronald A. Konser, ‘Materials and Processes in Manufacturing’, 5th Edition, Prentice Hall India Ltd., 1997.
4. P. N. Rao, Manufacturing Technology (Volume 1) – Foundry, Forging and Welding, 4th Edition, Tata McGraw Hill Education, New Delhi, 2013.
5. Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes and Systems, Publishers: Wiley India, 2012.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Manufacturing Process Technology I & II	Prof. Shantanu Bhattacharya	IIT Kanpur	12 weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.Jayaraman	Associate Professor	MECH/VMKVEC	jayaramanr@vmkvec.edu.in
2	C.Thangavel	Associate Professor	MECH/VMKVEC	thangavel@vmkvec.edu.in
3	P.Kumaran	Assistant Professor-II	MECH/AVIT	kumaranp@avit.ac.in

	FLUID MECHANICS AND MACHINERY (Theory and Practicals)	**Category**	**L**	**T**	**P**	**Credit**
34421C05		**CC**	**2**	**1**	**2**	**4**

Preamble

The aim of the subject is to provide a fundamental knowledge in fluid mechanics and machinery.

Prerequisite

NIL

Course Objectives

1	To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2	To impart basic knowledge of the kinematics of fluids and boundary layer concept.
3	To understand the importance of dimensional analysis.
4	To understand the importance of various types of flow in pumps.
5	To understand the importance of various types of flow in turbines.

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

CO1.	Apply mathematical knowledge to predict the properties and characteristics of a fluid.	Apply
CO2.	To understand the conservation laws applicable to fluids and its application through fluid kinematics and also to understand the concept of boundary layer and its thickness on the flat solid surface.	Understand
CO3.	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.	Apply
CO4.	Explain the working principles of centrifugal pumps and reciprocating pumps.	Understand
CO5.	Explain the working principles of various turbines and design the various types of turbines.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	M	M	L
CO2	S	S	M	L	-	-	-	-	-	-	-	-	M	M	L
CO3	S	S	M	L	-	-	-	-	-	-	-	-	M	M	L
CO4	S	S	S	S	-	-	-	-	-	-	-	-	M	M	L
CO5	S	S	S	S	-	-	-	-	-	-	-	-	M	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC CONCEPTS AND PROPERTIES

Definition of fluid-mechanics-Properties of fluids-mass density, specific weight, specific volume, specific gravity-Viscosity-Newton's law of viscosity-Compressibility and Buk modulus, Surface tension and Capillarity-Vapor pressure-Continuity equation (one and three dimensional differential forms)-Bernoulli'sequation and its assumptions.

KINEMATICS AND BOUNDARY LAYER OF FLUID FLOW

Types of fluid flow - Velocity and acceleration – Velocity Potential Function -Stream Function-Types of motion –Vortex flow-Euler's equation of motion-Flow of viscous fluid through circular pipe-Major and Minor losses-Darcy Weisbach's equation-Boundary layer concepts-Types of boundary layer thickness-Separation of Boundary Layer

DIMENSIONAL ANALYSIS

Fundamental dimensions -Dimensional homogeneity-Methods of dimensional analysis-Model analysis -Similitude –Types of similitude-Dimensionless Numbers-Types of dimensionless numbers-Model laws–Classification of models.

HYDRAULIC PUMPS

Classification of pumps-Centrifugal pumps-Working principles-Work done by the impeller-Velocity Triangles-Heads and efficiencies of centrifugal pumps-Characteristic curves of centrifugal pumps-Cavitations in centrifugal pumps-Net Positive Suction Head (NPSH)- Reciprocating pumps-

Working principles-Slip and negative slip of reciprocating pump-Classification of reciprocating pumps-Indicator diagram and it's variations - Work saved by fitting air vessels

HYDRAULIC TURBINES

Classification of turbines-Heads and efficiencies- Pelton wheel -Velocity triangles- Radial flow reaction turbines- -Francis turbine-Axial flow reaction turbines-Working principles – Draft-Tube-Specific speed-Unit quantities-Performance curves for turbines –Governing of turbines.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge given Orifice Meter
2. Determination of the Coefficient of discharge given Venturi Meter
3. Determination of friction factor for a given set of pipes.
4. Conducting experiments and drawing the characteristic curves of Centrifugal Pump/Submersible Pump
5. Conducting experiments and drawing the characteristic curves of Reciprocating Pump
6. Conducting experiments and drawing the characteristic curves of Gear Pump
7. Conducting experiments and drawing the characteristic curves of Jet Pump
8. Conducting experiments and drawing the characteristic curves of Kaplan Turbine
9. Study about the performance characteristics curves of Pelton wheel & Francis Turbine

Text Books

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition 2019.
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Bansal- R.K. - "Fluid Mechanics and Hydraulics Machines"- (9th edition)–Laxmi Publications (P) Ltd- New Delhi 2010.

Reference Books

1. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
2. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
3. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
4. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	Dr.S.Arunkumar	Associate Professor	MECH/VMKVEC	arunkumar@vmkvec.edu.in
2	B.Selva Babu	Assistant Professor	MECH/AVIT	selvababu@avit.ac.in

	MECHANICS OF MACHINES (Theory and Practicals)	Category	L	T	P	Credit
34421C08		CC	2	1	2	4

Preamble

The students completing this course are expected to understand the role of mechanisms and its applications.

Prerequisite NIL

Course Objectives

1	To Demonstrate the various types of kinematics of mechanisms.
2	To study the gear nomenclature and illustrate the various types of gears and gear trains.
3	To study and construct the cam profile.
4	To categorize the knowledge of static force analysis.
5	To analyze the balancingof masses and vibrations.

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

CO1.	Explain the principles involved in mechanics of machines.	Understand
CO2.	Solve problems related to gear tooth for various applications	Apply
CO3.	Construct cams and followers for specified motion profiles.	Apply
CO4.	Analyze about the various static and dynamic forces.	Analyze
CO5.	Analyze balancing problems in rotating and reciprocating parts of machinery.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	M	M	L
CO2	S	S	M	L	-	-	-	-	-	-	-	-	M	M	L
CO3	S	S	M	L	-	-	-	-	-	-	-	-	M	M	L
CO4	S	S	S	S	-	-	-	-	-	-	-	-	M	M	L
CO5	S	S	S	S	-	-	-	-	-	-	-	-	M	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

KINEMATIC OF MECHANICS

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods.

GEARS AND GEAR TRAINS

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains

KINEMATICS OF CAM

Classifications - Displacement diagrams-parabolic- Simple, harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion

FORCE ANALYSIS

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‘Alembert‘s principle – superposition principle – dynamic Force Analysis in simple machine members.

BALANCING AND VIBRATION

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines-Direct and reverse crank method-Free vibrations – Equations of motion – natural Frequency – Damped Vibration –critical speed ofsimple shaft – Torsional vibration – Forced vibration

LIST OF EXPERIMENTS

1. To perform an experiment on Watt and Porter Governor to prepare performance characteristic curves and to find stability and sensitivity
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation
3. To analyse the motion of a motorized gyroscope when the couple is applied along its spin axis and determine gyroscopic couple
4. Determine the Moment of Inertia by compound pendulum and tri-filar suspension.
5. To determine the frequency of undamped free vibration and damped forced vibration of an equivalent spring mass system.
6. To determine whirling speed of shaft theoretically and experimentally.

Text Books

1. Ambekar A.G., ―Mechanism and Machine Theory Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., ―Theory of Machines and Mechanisms, Oxford University Press, 2003
3. Khurmi.R.S. and Gupta, Theory of Machines, S.Chand @ Co., 2005.

Reference Books

1. Thomas Bevan, ―Theory of Machines, CBS Publishers and Distributors, 1984.
2. Ghosh.A, and A.K.Mallick, ―Theory and Machine, Affiliated East-West Pvt. Ltd., New Delhi,
3. Rao.J.S. and Dukkipatti R.V. ―Mechanisms and Machines, Wiley-Eastern Ltd., New Delhi, 1992.
4. Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2002
5. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2004.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Kinematics of Mechanisms and Machines	Prof. A. Dasgupta	IIT Kharagpur	12 Weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.S.Venkatesan	Professor	MECH/ VMKVEC	venkatesan@vmkvec.edu.in
2	S.Sathiyaraj	Assistant Professor-II	MECH/AVIT	sathiyaraj@avit.ac.in

	MECHANICAL BEHAVIOUR OF MATERIALS AND METALLURGY (Theory and Practicals)	Category	L	T	P	Credit
34421C03		CC	3	0	2	4

Preamble

This course to imparts through knowledge on the metallic and nonmetallic materials, mechanical testing methods and deformation mechanisms in crystalline solid materials, also the mechanical treatment process, corrosion and advanced materials pertaining to Mechanical Engineers.

Prerequisite

NIL

Course Objectives

1	To develop the broad knowledge of the classification, properties and application of various Engineering Materials.
2	To provide an understanding to students on the mechanical properties and performance of materials.
3	Identify the suitable mechanical treatment methods for selecting ferrous and non ferrous materials.
4	Develop the knowledge of the various forms of corrosion and powder metallurgy fabrication methods
5	To give insight to advanced materials such as polymers, ceramics and composite and their applications.

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

CO1.	Understand the concepts of structure properties, performance and processing related to metallurgy and materials.	Understand
CO2.	Evaulate the mechanical behaviour of materials and the effect of mechanical properties.	Apply
CO3.	Correlate the structure-property relationship in metal/alloys in as-received and heat-treated conditions.	Apply
CO4.	Predict the formation of corrosion, mechanism and to prevent corrosion and powder metallurgy fabrication methods.	Apply
CO5.	Apply advanced materials such as polymers, ceramics and composites in product design.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	-	-	-	M	M	-	-
CO2	S	M	-	-	-	-	-	-	-	-	M	S	M	-	M
CO3	S	S	M	-	-	-	-	-	-	-	-	S	M	-	M
CO4	S	S	-	-	-	S	-	S	-	-	-	S	M	-	M
CO5	S	S	-	-	S	-	-	-	-	-	-	S	M	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

FERROUS & NON-FERROUS MATERIALS

Classification of cast iron and steels – properties, microstructures and uses of cast irons, plain carbon, alloy steels, HSLA, stainless, tool and die steels & maraging steels. Properties, microstructures and uses of non – ferrous alloys – copper, aluminium and nickel alloys. Phase diagrams - Iron – Iron carbide equilibrium diagram.

MECHANICAL BEHAVIOR OF MATERIALS

Introduction to plastic deformation - Slip and twinning – Types of fracture – ductile fracture, brittle fracture, - Fatigue – Fatigue test, S-N curves, Creep and stress rupture fatigue – mechanism of creep. Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers & Rockwell), Impact test Izod and charpy.

MATERIAL TREATMENT

Heat treatment - Overview- objectives – Annealing and types, Normalizing - Hardening and

Tempering, Austempering and martempering. Case hardening process- Carburizing- nitriding - cyniding and carbonitriding, flame and induction hardening. Hardenability - Jominy end quench test.Time Temperature Transformation (TTT) and Cooling Curve Transformation (CCT) curve.

POWDER METALLURGY AND CORROSION

Powder metallurgy–powder production, blending, compaction, sintering-applications, Introduction- forms of corrosion-pitting, intergranular, stress corrosion, corrosion fatigue, dezincification, erosion-corrosion, Crevice Corrosion, Fretting-Protection methods - PVD, CVD.

INTRODUCTION TO ADVANCED MATERIALS

Polymers – types of polymer, Properties and applications of various Engineering polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI,PAI,PPO,PPS,PEEK, PTEF, Urea and phenol formaldhydes. Composites - Types- Metal Matrix Composites (MMC), Polymer Matrix Composites (PMC), Ceramic Matrix Composites (CMC) – properties, processing and applications. Ceramics – properties and applications of SiC, Al2O3, Si3N4, PSZ and SIALON

LIST OF EXPERIMENTS

1. Introduction to Metallographic
2. Preparation metallographic specimen
3. Identification of Ferrous specimens (Minimum 5)
4. Identification of Non-Ferrous specimen (Minimum 2)
5. Heat treatment – Annealing – comparation between annealed and unheat treated specimen.
6. Heat treatment – Normalizing – comparation between annealed and unheat treated specimen.

Text Books

1. William D Callister "Material Science and Engineering", John Wiley and Sons 2010–8thEdition.
2. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company – Prentice Hall2014- 8th Edition.
3. V. Raghavan , " Materials Science and Engineering", PHI, Sixth Edition

Reference Books

1. George E. Dieter, "Mechanical Metallurgy" – TATA McGraw Hill – 2013 – 3rd Edition
2. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India
3. Upadhyay. G.S. and AnishUpadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd.,New Delhi, 2006.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Mechanical Behaviour of Materials	Prof. S. Shankar	IIT Madras	12 Weeks
2	Materials Science and Engineering	Dr. Vivek Pancholi	IIT Roorkee	12 Weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.S. Arunkumar	Assoc. Professor	MECH/VMKVEC	arunkumar@vmkvec.edu.in
2	Dr.M.Thiruchirambalam	Professor	MECH/AVIT	thiru.mech@avit.ac.in

	STRENGTH OF MATERIALS (Theory and Practicals)	**Category**	**L**	**T**	**P**	**Credit**
34421C06		**CC**	**2**	**1**	**2**	**4**

Preamble

The students completing this course are expected to understand the role of mechanisms and its applications.

Prerequisite

NIL

Course Objectives

1	To know the behavior of material at various loading conditions in compression and tension.
2	Understand and analyze shear force and bending moment in various loading conditions.
3	To know the phenomenon of bending of different sections and its analysis and recognize principle stresses.
4	To understands various columns sections and geometrical analysis.
5	Concepts of strain energy, torsion and numerical analysis.

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

CO1.	Explain the behavior of material at various loading conditions in compression and tension.	Understand
CO2.	Analyze shear force and bending moment in various loading conditions.	Apply
CO3.	Analyze the phenomenon of bending of different sections and recognize principle stresses.	Analyze
CO4.	Analyze about the various columns sections and geometrical.	Analyze
CO5.	Analyze of strain energy, torsion and numerical analysis.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**
CO2	**S**	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**
CO3	**S**	**S**	**S**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**
CO4	**S**	**S**	**S**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**
CO5	**S**	**S**	**S**	**S**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**L**

S- Strong; M-Medium; L-Low

SYLLABUS

STRESSES AND STRAINS

Stress and strain due to axial force – Strain energy due to axial force –sudden load and impact load. Poisson's ratio– volumetric strain– shear stress–shear strain. Thin cylindrical and spherical shells under internal pressure. Thermal stresses. Principal stresses and planes – Mohr's circle for plane stress and plane strain. Strain gauges and rosettes.

BENDING MOMENT AND SHEAR FORCE IN BEAMS

Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments – maximum bending moment and point of contra flexure.

FLEXURE & TORSION IN BEAMS

Theory of simple bending and assumptions – flexure equation. Theory of torsion and assumptions – torsion equation – power transmitted by a shaft.

DEFLECTION OF DETERMINATE BEAMS

Governing differential equation – Macaulay's method – moment area method – application to simple problems (cantilever beams and simply supported beams only).

COLUMNS AND STRUTS

Columns – behaviour of axially loaded short and long column members – buckling load – Euler's theory – different end conditions – Rankine's formula.

LIST OF EXPERIMENTS

1. Direct Shear Test on Mild Steel Rod and Mild Steel Plate
2. Brinell Hardness Test
3. Izod Impact Test
4. Bending Test on Mild Steel
5. Rockwell Hardness Test
6. Tensile Test on Mild Steel
7. Compression test& Torsion test on Mild Steel

Text Books

1. Bedi D.S., "Strength of Materials", Khanna Publishing House, 2017.
2. Jindal U C, "Strength of Materials", Asian Books Pvt Ltd, New Delhi, 2007.
3. Rajput.R K, "Strength of Materials", S.Chand& Co Ltd, New Delhi, 1996.

Reference Books

1. Egor P Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 1997
2. Subramanian R, "Strength of Materials", Oxford University Press, Oxford Higher Education Series, Oxford, 2007
3. Hibbeler R.C, "Mechanics of Materials", Pearson Education, New Jersey, 2007
4. Bansal R.K, "Strength of Materials", Lakshmi Publications(P)Ltd, New Delhi,2010
5. Ferdinand P Been, Russell Johnson,J.R. and John J Dewole, "Mechanics of Materials", Tata Mcgraw Hill Publishing Co Ltd, New Delhi, 2006

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	STRENGTH OF MATERIALS	PROF. SRIMAN KUMAR BHATTACHARYYA	IIT KGP	12 Weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.S.Sangeetha	Associate Professor	MECH/AVIT	sangeethas@avit.ac.in
2	R.Chandrasekar	Assistant Professor	MECH / VMKVEC	chandrasekar@vmkvec.edu.in

	ENGINEERING THERMODYNAMICS (Theory and Practicals)	**Category**	**L**	**T**	**P**	**Credit**
34421C04		**CC**	**2**	**1**	**2**	**4**

Preamble

This course provides an introduction to the basic concepts in thermodynamics, first law of thermodynamics and energy, second law, entropy, enthalpy and internal energy, ideal and real gases and non-reactive ideal gas mixtures and general thermodynamic property relations. It develops the problem solving skills in engineering problems in basic thermodynamics.

Prerequisite

Nil

Course Objectives

1	To learn about work and heat interactions, and balance of energy between system and its surroundings.
2	To learn about application of I law to various energy conversion devices.
3	To evaluate the changes in properties of substances in various processes.
4	To understand the difference between high grade and low grade energies.
5	To understand the II law limitations on energy conversion.

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

CO1.	To assess the basic elements & various modes of heat transfer Used in Engineering applications.	Understand
CO2.	To solve the engineering problems using various methods of Transient heat conduction technologies	Apply
CO3.	To apply the concepts of convection systems in an engineering problem using standard values	Apply
CO4.	To choose the various concepts of radiation based on the requirements for the given problems	Apply
CO5.	To solve the engineering problems using Boiling , Condensation and heat transfer rate of heat exchangers using LMTD and NTU method	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**L**	**L**	**-**	**-**	**-**	**S**	**S**	**S**	**-**	**-**	**S**	**M**	**-**
CO2	**S**	**M**	**L**	**L**	**-**	**-**	**-**	**S**	**S**	**S**	**-**	**-**	**S**	**M**	**-**
CO3	**S**	**M**	**L**	**L**	**-**	**-**	**-**	**S**	**S**	**S**	**-**	**-**	**S**	**M**	**-**
CO4	**S**	**M**	**L**	**L**	**-**	**-**	**-**	**S**	**S**	**S**	**-**	**-**	**S**	**M**	**-**
CO5	**S**	**M**	**L**	**L**	**-**	**-**	**-**	**S**	**S**	**S**	**-**	**-**	**S**	**M**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF THERMODYNAMIC

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

FIRST AND SECOND LAW OF THERMODYNAMICS

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale

CLAUSIUS INEQUALITY, IRREVERSIBILITY AND AVAILABILITY

Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluationof S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Energy balance equation and Exergy analysis.

PURE SUBSTANCE AND GAS MIXTURES

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart

THERMODYNAMIC CYCLES AND RELATIONS

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. Thermodynamic relations: Thermodynamic potentials, thermodynamic gradients, general thermodynamics relations, entropy (Tds) equations, equations for internal energy and enthalpy, equation of state, coefficient of expansion and compressibility, specific heats, Joule Thomson coefficient, Clausius –Claperyon equation, Maxwell's relations.

LIST OF EXPERIMENTS

IC Engine Valve Timing diagrams.
IC Engine Port Timing diagrams.
Determination of Flash Point and Fire Point of Various fuels / Lubricant
Determination of Viscosity of Various fuels / Lubricant
Actual P-V diagrams of IC engines.
Determination of Calorific value of liquid fuel

Text Books

1. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
2. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference Books

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Basic Thermodynamics	Prof. Suman Chakraborty	IIT Kharagpur	12 weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.Anandan	Associate Professor	MECH/VMKVEC	anandan@vmkvec.edu.in
2	Dr.P. Sellamuthu	Associate Professor	MECH/VMKVEC	sellamuthu@vmkvec.edu.in
3	C.Thiagarajan	Associate Professor	MECH/AVIT	cthiagarajan@avit.ac.in

		Category	L	T	P	Credit
34421C09	THERMAL ENGINEERING (Theory and Practicals)	CC	2	1	2	4

Preamble

This course imparts understanding about the power generation using heat energy conversion and makes an attempt to be conversant with the equipment's used in the process. It helps in understanding the thermodynamic concepts, the construction and the working principles of various engineering devices

Prerequisite

Engineering Thermodynamics

Course Objectives

1	To learn about of reacting systems and heating value of fuels.
2	To learn about gas and vapor cycles and their first law and second law efficiencies.
3	To understand about the properties of dry and wet air and the principles of psychrometry.
4	To learn about gas dynamics of air flow and steam through nozzles.
5	To learn the about reciprocating compressors with and without intercooling and performance of steam turbines.

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

CO1.	To assess the basic of reacting systems and heating value of fuels	Understand
CO2.	Apply the gas and vapor cycles and their first law and second law efficiencies	Apply
CO3.	Apply the properties of dry and wet air and the principles of psychrometry	Apply
CO4.	Apply the concept of gas dynamics of air flow and steam through nozzles	Apply
CO5.	Analyze the reciprocating compressors with and without intercooling and performance of steam turbines	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO2	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO3	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO4	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO5	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO SOLID, LIQUID AND GASEOUS FUELS

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

GAS AND VAPOR CYCLES

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

PROPERTIES OF DRY AND WET AIR

Properties of dry and wet air,use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

COMPRESSIBLE FLOW

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

RECIPROCATING COMPRESSORS AND STEAM TURBINE

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.
Analysis of steam turbines, velocity and pressure compounding of steam turbines

LIST OF EXPERIMENTS

1. Load Test on a four stroke Single cylinder diesel engine.
2. Load Test on a four stroke twin cylinder diesel engine.
3. Performance and Emission test of a four stroke multi-cylinder Petrol engine.
4. Performance and Emission test of a four stroke multi-cylinder Diesel engine.
5. Morse Test on a multi-cylinder petrol engine.
6. Performance test of a bio-fuel on a variable compression ratio engine.

Text Books

1. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
2. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference Books

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Alternative NPTEL/SWAYAM Course - Nil

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Nil			

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.Anandan	Associate Professor	MECH/VMKVEC	anandan@vmkvec.edu.in
2	Dr.P. Sellamuthu	Associate Professor	MECH/VMKVEC	sellamuthu@vmkvec.edu.in
3	C.Thiagarajan	Associate Professor	MECH/AVIT	cthiagarajan@avit.ac.in

	DESIGN OF MACHINE ELEMENTS	**Category**	**L**	**T**	**P**	**Credit**
34421C11		**CC**	**2**	**1**	**0**	**3**

Preamble

Students will be able to demonstrate the fundamentals of stress analysis, theories of failure and material science in the design of machine components. Students will be able to make proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components. Enable the students to have high ethical standards in terms of team work to be a good design engineer

Prerequisite

NIL

Course Objectives

1	Develop an ability to apply knowledge of mechanics and materials.
2	Develop an ability to design various machine elements with practical constraints by applying standard design procedures.
3	Utilize the codes and standard design principles.
4	Apply Design principles and validation for critical safety analysis.
5	Understand the background in material failure through the study of theories of failure.

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

CO1.	Explain the influence of steady and variable stresses in machine component design.	Understand
CO2.	Apply the design principles in shafts and couplings for defined constraints.	Apply
CO3.	Apply the design principles in bolted and welded joints for defined constraints.	Apply
CO4.	Apply the design principles in mechanical springs for steady and varying load conditions	Apply
CO5.	Apply the design principles in bearing and flywheel for defined constraints	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**S**	**S**	**L**	**-**	**-**	**-**	**M**	**L**	**L**	**-**	**-**	**S**	**-**	**-**
CO2	**S**	**S**	**S**	**M**	**-**	**-**	**-**	**M**	**L**	**L**	**-**	**-**	**S**	**-**	**-**
CO3	**S**	**S**	**S**	**M**	**-**	**-**	**-**	**M**	**L**	**L**	**-**	**-**	**S**	**-**	**-**
CO4	**S**	**S**	**S**	**M**	**-**	**-**	**-**	**M**	**L**	**L**	**-**	**-**	**S**	**-**	**-**
CO5	**S**	**S**	**S**	**M**	**-**	**-**	**-**	**M**	**L**	**L**	**-**	**-**	**S**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO DESIGN PROCESS WITH VARIOUS STRESS COMBINATIONS

Introduction to the design process - factor influencing machine design – Direct – Bending and torsional stress equations –Impact and shock loading-Calculation of principal stresses for various load combinations – Factor of safety-theories of failure–stress concentration –design for variable loading – Soderberg – Goodman and Gerber relations

DESIGN OF SHAFTS AND COUPLINGS

Design of solid and hollow shafts based on strength – rigidity and critical speed – Design of rigid and flexible couplings.

DESIGN OF BOLTED AND WELDED JOINTS

Threaded fasteners – Design of bolted joints – Design of welded Joints for pressure vessels and structures- Theory of Bolted joints

DESIGN OF SPRINGS

Design of helical, leaf and torsional springs under constant loads and varying loads.

DESIGN OF BEARINGS AND FLYWHEELS

Design of bearings – sliding contact and rolling contact types – Design of journal bearings calculation ofbearing dimensions- Design of flywheels involving stresses in rim and arm.

Text Books

1. Design of Machine Elements-V.B.Bhandari
2. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke

Reference Books

1. Machine Design: Robert L.Norton,Pearson Education,2001
2. Design of Machine Elements-M.F.SPotts,T.E.Shoup,pearsonEdn,2006.
3. Fundamentals of Machine component Design–Robert C.Juvinall,Wiley India Pvt.Ltd,3rdEdn,2007.
4. Design Data – PSG College of Technology, DPV Printers, Coimbatore, 2012.
5. P.C.Sharma&D.K.Aggarwal, A Text Book of Machine Design, S.K.Kataria& Sons, New Delhi,12th edition, 2012 .

Alternative NPTEL/SWAYAM Course – Nil

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
	-	-	-	-

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.Venkatesh	Assistant Professor	MECH/VMKVEC	venkatesh@vmkvec.edu.in
2	J. Senthil	Associate Professor	MECH/AVIT	jsenthil@avit.ac.in

	ENGINEERING METROLOGY AND MEASUREMENTS (Theory and Practicals)	**Category**	**L**	**T**	**P**	**Credit**
34421C13		**CC**	**3**	**0**	**2**	**4**

Preamble

The aim of the subject is to provide basic knowledge in instrumentation and measurements. Familiarization with basic concepts and different instrumentation and measurement strategies being usedin practice.

Prerequisite

NIL

Course Objectives

1	To apply the fundamentals of basic engineering measurement system.
2	To understand the various instruments used for linear, angular measurement, form measurement and surface finish
3	To apply the knowledge of different measuring instruments like linear, angular measurement, form measurement and surface finish
4	To understand the principle, concepts, applications and advancements of temperature, pressure and flow measurements
5	To use information to classifications, working and processes of optical measuring instruments, also to acquire the data and store in computer

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

CO1.	Explain the sensitivity of the instruments by evaluating the error in measurements	Understand
CO2.	Discuss the working principle and usage of various instruments used for linear, angular measurement, form measurement and surface finish	Understand
CO3.	Demonstrate the various setups used for measuring linear, angular measurement, form measurement and surface finish	Apply
CO4.	Determine the appropriate instruments for temperature, pressure and flow measurements	Apply
CO5.	Explain the application oriented knowledge in the use of optical measuring instruments	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**-**	**-**
CO2	**S**	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**-**	**-**
CO3	**S**	**L**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**-**	**-**
CO4	**S**	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**-**	**-**
CO5	**S**	**M**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC PRINCIPLES & LINEAR / ANGULAR MEASUREMENT

Basic principles of measurement - Generalized measuring system - Characteristics of measuring instruments, Static and Dynamic characteristics - Precision, Accuracy, Sensitivity, Repeatability, Reproducibility, Linearity, Errors –sources of error, classification and elimination of error- Calibration. Linear and angular Measurements: Vernier – Micrometer - Slip gauges and classification - Optical flats - Limit gauges - Comparators: Mechanical - Pneumatic and Electrical types – applications. -Sine bar - optical bevel protractor - Autocollimator- Angle Decker – Taper measurements.

DISPLACEMENT, SPEED & ACCELERATION / VIBRATIONMEASUREMENT

Measurement of displacement: Theory and construction of various transducers to measure displacement - LVDT, piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.
Measurement of speed: Mechanical tachometers, electrical tachometers, strobe Objective, noncontact type of tachometer.
Measurement of acceleration and vibration: Piezoelectric Accelerometer, Seismic Accelerometer, Vibrometer.

TEMPERATURE, PRESSURE AND FLOW MEASUREMENT

Measurement of Temperature: Classification, ranges, various principles of measurement, expansion, electrical resitance, Thermistor, Thermo couples, Pyrometers, temperature Indicators. Measurement of pressure: Units, classification, different principles used, piston Digital pressure gauges, Manometers, bourdon, pressure gauges, bellows diaphragm gauges. Low pressure measurement, thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge, Knudsen gauge. Calibration of pressure gauges. Measurement of level: Direct method – indirect methods– capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – bubler level indicators
Measurement of flow: Orifice meter, Venturi meter, Rotameter, magnetic, ultrasonic, turbine flow meter, Anemometers - hotwire anemometer, Laser Doppler anemometer (LDA).

FORCE, TORQUE, & STRAIN MEASUREMENTS

Measurement of force& torque: Load cells, Dynamometers: Eddy current dynamometer, Cantilever beams, proving rings, differential transformers.
Measurement of torque: Torsion bar dynamometer, servo controlled dynamometer, absorption dynamometers. Power Measurements.
Strain Measurements: types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge calibration.

FORM MEASUREMENTS AND OPTICAL MEASUREMENTS

Form measurements: Measurement of screw threads - thread gauges - Floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method- Gleason gear testing machine – radius measurements-surface finish - Straightness - Flatness and roundness measurements.
Optical measurements: Optical Micro Objective, interference micro Objective, tool makers micro Objective, profile projector, vision Systems, laser interferometer – linear and angular measurements.

LIST OF EXPERIMENTS

1. Angular Measurements using Bevel Protector and Sine Bar
2. Measurement of linear parameters using precision measuring instruments like micrometer, Vernier caliper and Vernier height gauge.
3. Flow Measurement using a Rotameter.
4. Fundamental dimension measurement of a gear using a contour projector.
5. Measurement of Displacement using Linear Variable Differential Transducer
6. Measurement of speed of Motor using Stroboscope
7. Measurement of cutting forces using Lathe Tool Dynamometer

Text Books

1. Kumar D.S., Mechanical Measurements and Control, Tata McGraw Hill.
2. Jain R.K., Engineering Metrology, Khanna Publishers, 1994.
3. GuptaS.C.- "Engineering Metrology"- Dhanpatrai Publications- 2018.
4. Metrology and Measurements lab Manual

Reference Books

1. Alan S. Morris- "The Essence of Measurement"- Prentice Hall of India- 1997
2. Jayal A.K- "Instrumentation and Mechanical Measurements"- Galgotia Publications 2000
3. Beckwith T.G- and N. Lewis Buck- "Mechanical Measurements"- Addison Wesley- 1999.
4. Donald D Eckman- "Industrial Instrumentation"- Wiley Eastern-1985.

Alternative NPTEL/SWAYAM Course				
S.No	**NPTEL /SWAYAM Course Name**	**Instructor**	**Host Institution**	**Duration**
1	Engineering Metrology	Prof. J. Ramkumar, Prof. Amandeep Singh	IIT Kanpur	12 Weeks

Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	S.Duraithilagar	Associate Professor	MECH/VMKVEC	duraithilagar@vmkvec.edu.in
2	R.Mahesh	Assistant Professor	MECH/AVIT	mahesh@avit.ac.in

	AUTOMOBILE ENGINEERING	**Category**	**L**	**T**	**P**	**Credit**
34421C10	**(Theory and Practicals)**	**CC**	**3**	**0**	**2**	**4**

Preamble

Automobile Engineering is a blend of both practical and theories, course the students will be able to learn the layout and arrangement of principal parts of an automobile, Engine Management and Emission Control System, working of Transmission, Suspension, Steering and brake systems along with the Advance in AutomobileEngineering.

Prerequisite

NIL

Course Objectives

1	To impart knowledge on the constructional details and principle of operation of various Automobile components.
2	To analyzing the various types Engine Auxiliary and Engine management systems.
3	To analyzing the various types of transmission systems for a vehicle
4	To analyzing the working parameters of various braking and suspension system in a Vehicle
5	To Analyzing the Various advance in automobile Engineering

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

CO1.	Recognize the various parts of the automobile and their functions and materials.	Apply
CO2.	Analyzing the various types Engine Auxiliary and Engine management systems.	Analyze
CO3.	Analyzing the various types of transmission systems for a vehicle	Analyze
CO4.	Analyzing the working parameters of various braking and suspension system in a vehicle	Analyze
CO5.	Analyzing the Various advance in automotive Engineering.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**L**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**S**	**-**	**-**
CO2	**S**	**L**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**S**	**-**	**-**
CO3	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**S**	**-**	**-**
CO4	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**S**	**-**	**-**
CO5	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**S**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

VEHICLE STRUCTURE AND ENGINES

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics, IC engines –components-functions and materials, variable valve timing (VVT).

ENGINE MANAGEMENT & EMISSION CONTROL SYSTEMS

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), Engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

TRANSMISSION SYSTEMS

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, overdrive, transfer box, fluid flywheel – propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive

STEERING, BRAKING AND SUSPENSION SYSTEMS

Steering Geometry,Types of steering Gearbox – Power Steering, Front Axle, Stub Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, ABS and Traction Control.

ADVANCES IN AUTOMOBILE ENGINEERING

Passenger comfort - Safety and security - HVAC - Seat belts - Air bags - Automotive Electronics - Electronic Control Unit (ECU). Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program (ESP) Traction Control System (TCS) - Global Positioning System (GPS) - Electric - Hybrid vehicle.

LIST OF EXPERIMENTS

1. Construction Mechanism of Petrol and Diesel engine (Four stroke and Two Stoke)
2. Construction Mechanism of Clutch Assembly
3. Construction Mechanism of Sliding mesh, Constant mesh and Synchromesh gear boxes
4. Construction Mechanism of Differential and Rear axles assembly
5. Construction Mechanism of Hydraulic brake, Disc brake and Air brake systems
6. Construction Mechanism of Suspension and Steering systems
7. Construction Mechanism of Hybrid and Electric vehicles

Text Books

1. Kirpal Singh, "Automobile Engineering Vol 1 & 2 ", Standard Publishers, Seventh Edition, New Delhi R.B. Gupta- "Automobile Engineering "- SatyaPrakashan.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi.
3. Gill P.S., "A Textbook of Automobile Engineering – Vol. I , II and III", S.K.Kataria and Sons, 2ndEdition.

Reference Books

1. William Crouse- "Automobile Engineering Series "- McGraw-Hill
2. Newton and Steeds- "Motor Vehicles "- ELBS
3. Duffy Smith- "Auto Fuel Systems "- The Good Heat Willcox Company Inc.
4. "Hybrid and Electric Vehicles"-CRC Press – Taylor and Francis Group.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Fundamentals of Automotive Systems	Prof C.S. Shankar Ram	IIT Madras	12 Weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	T. Raja	Associate Professor	MECH/VMKVEC	rajat@vmkvec.edu.in
2	N. Shivakumar	Assistant Professor	MECH/AVIT	shivakumar@avit.ac.in

	COMPUTER INTEGRATED MANUFACTURING	**Category**	**L**	**T**	**P**	**Credit**
34421C07	**(Theory and Practicals)**	**CC**	**3**	**0**	**2**	**4**

Preamble

The students completing this course are expected to understand the nature and role of computers in manufacturing. The course includes computer aided design, fundamentals of CNC machines, programming of CNC machines, group technology, computer aided process planning techniques, shop floor control and flexible manufacturing systems. It exposes the students to various current trends followed in the industries

Prerequisite

NIL

Course Objectives

1	Demonstrate basics of CAD/CAM/CIM concepts.
2	To apply geometric modelling techniques and various graphics standards in CAD.
3	Illustrate with tooling and fixtures in CNC programming and machining.
4	Demonstrate part programs and group technology techniques.
5	Discuss latest advances in the manufacturing perspectives.

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

CO1	Understand basic concept of CAD/CAM/CIM	Understand
CO2	Utilize CAD standards for geometrical modelling. Demonstrate Solid modelling techniques.	Apply
CO3	Interpret and demonstrate complex programs for CNC machining centers	Apply
CO4	Apply group technology concept in manufacturing product. Make use of FEA concept for analysis.	Apply
CO5	Explain FMS and CIM wheel for manufacturing industry, discuss the latest advances in the manufacturing perspectives.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO2	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO3	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO4	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO5	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Definition and scope of CAD/CAM- Computers in industrial manufacturing, design process- Computer Aided Design (CAD)-Computer Aided Manufacturing (CAM)-Computer Integrated Manufacturing (CIM) - Introduction to Computer graphics -Raster scan graphics-Co-ordinate systems.

GRAPHICS AND COMPUTING STANDARDS

Data base for graphic modeling-transformation geometry-3D transformations –Clipping-hidden line removal-Colour-shading-Standardization in graphics- Open GL Data Exchange standards – IGES, STEP - Graphic Kernal system (GKS). Geometric construction methods-Constraint based modeling- Wireframe, Surface and Solid – Parametric representation of curves, solids & surfaces.

CNC MACHINE TOOLS

Introduction to NC, CNC, DNC - Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD/ CAM approach to NC part programming – APT language, machining from 3D models.

GROUP TECHNOLOGY & FEA CONCEPTS

Group technology-coding-Production flow analysis-computer part- programming-CAPP implementation techniques. Nodes -Meshing – Pre and Post processing – Modal analysis – Stress analysis – Steady state and Transient analysis.

AUTOMATED MANUFACTURING SYSTEMS

Flexible Manufacturing systems (FMS) – the FMS concepts – transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering, Virtual Reality, Augmented Reality –automated guided vehicle-Robots-automated storage and retrieval systems - computer aided quality control-CMM-Non contact inspection methods.

LIST OF EXPERIMENTS

1. 2D Geometry –Splines
2. Surface Modelling –NURBS
3. Solid Modelling-CSG, Brep.
4. Preparing solid models for analysis-Neutral files
5. Real time component analysis-STRESS, STRAIN Analysis.
6. Model analysis of different structures.
7. Tolerance analysis of any mechanical component.
8. CNC Milling program involving linear motion and circular interpolation
9. CNC Milling program involving contour motion and canned cycles
10. CNC Milling program involving Pocket milling.
11. CNC Turning program involving turning and facing
12. CNC Turning program involving Step turning, Taper turning and Grooving
13. CNC Turning program involving Fixed/Canned cycles& Thread cutting cycles
14. Diagnosis and trouble shooting in CNC machine
15. Route sheet generation using CAM software.
16. Generation of CNC programming and machining using Master Cam/Edge Cam.

Text Books

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated
2. Radhakrishnan P, Subramanyan.S. andRaju V., "CAD/CAM/CIM", New Age International (P) Ltd., New Delhi.
3. P.N.Rao, CAD/CAM: Principles and Applications-3rd Edition, Tata McGraw Hill, India, 2010.

Reference Books

1. Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill.
2. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International
3. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
4. Roger Hanman "Computer Integrated Manufacturing", Addison – Wesley
5. Viswanathan.N, Narahari.Y "Performance Modeling& Automated Manufacturing systems" Prentice hall of indiapvt. Ltd.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Computer Integrated Manufacturing	Prof. J. Ramkumar, Prof. Amandeep Singh	IIT Kanpur	12 weeks

Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	Dr.L.Prabhu	Associate Professor	MECH/ AVIT	prabhu@avit.ac.in
2	S.Prakash	Assistant Professor-II	MECH/ AVIT	prakash@avit.ac.in
3	M.Saravanan	Associate Professor	MECH/VMKVEC	saravanan@vmkvec.edu.in

		Category	L	T	P	Credit
34421C12	DESIGN OF TRANSMISSION SYSTEMS	CC	2	1	0	3

Preamble

Design of Transmission System course is concerned with design of mechanical transmission elements for engineering applications. In industries motors and turbines use energy to produce rotational mechanical motion. In order to harness this motion to perform useful work, there must be a way to transmit it to other components and machines. Three common methods of accomplishing this include gears, chain drives, and belt drives. The Mechanical Transmission Systems subject area covers these types of transmission systems, including specific applications, how each works.

Prerequisite

DESIGN OF MACHINE ELEMENTS

Course Objectives

1	To interpret the procedure for power transmission by belt, ropes and chain drives.
2	To design the spur and helical gears.
3	To design the bevel and worm gears.
4	To explore the importance of gear box and design of gear box.
5	To assess the design procedure for clutches and brakes.

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

CO1.	Design a suitable flat belt, V-belt, ropes and chain drive for specified loading condition by using pre-defined set of values and procedures.	Apply
CO2.	Determine the number of teeth, bending strength and wear strength for given spur gear, helical, bevel gear and worm gear pair by using pre-defined set of values and procedures.	Apply
CO3.	Determine the number of teeth, bending strength and wear strength for given bevel gear and worm gear pair by using pre-defined set of values and procedures.	Analyze
CO4.	Design the gearbox and gear shaft dimensions for given speed conditions byusing pre-defined set of values and procedures.	Apply
CO5.	Design of brakes by using pre-defined set of values and procedures and single plate clutch and multiple plate clutch for given specified loading conditions.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-
CO2	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-
CO3	M	S	S	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-
CO5	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

DESIGN OF FLEXIBLE DRIVES

Types and configuration of belt drive-slip-initial tension-centrifugal tension-selection of flat belt drive, Selection of V-belt drives- problems-based on basic equations. Types of chain-factor of safety-selection of chain drives. Design of Wire ropes.

DESIGN OF SPUR GEAR AND HELICAL GEARS

Gear nomenclature - Spur gears - Stresses induced in gears - gear tooth failure - Lewis bending equations, Calculation of appropriate safety factors and power rating - force analysis, Design of spur gears - helical

DESIGN OF BEVEL AND WORM GEARS

Gear nomenclature - Stresses induced in gears - gear tooth failure - Lewis bending equations - Calculation of appropriate safety factors and power rating - force analysis - Design of bevel and worm gears

DESIGN OF GEAR BOXES

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - peed reducer unit

DESIGN OF CLUTCHES AND BRAKES

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes – external shoe brakes – Internal expanding shoe brake.

Text Books

1. Joseoh Edward Shigley, Charles R Misucke, Mechanical Engineering Design, Tata Mc Graw Hill.
2. Prabhu. T.J. - –Design of Transmission Elements- Mani Offset- Chennai.
3. V.B. Bhandari, –Design of Machine Elements, Tata McGraw Hill.

Reference Books

1. Md.Jalaludeen- Machine Design- Anuradha Publicatiions, Chennai
2. Maitra G.M. - Prasad L.V. - –Hand book of Mechanical Design- II Edition- Tata McGraw-
3. Sundarajamoorthy T.V. and Shanmugam. N, –Machine Design, Anuradha Publications
4. Design Data, PSG College of Technology, Coimbatore.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	S.Kalyanakumar	Assistant Professor	MECH/AVIT	kalyanakumar @avit.ac.in
2	J Satheesbabu	Associate Professor	MECH/VMKVEC	satheesbabu@vmkvec.edu.in

		Category	L	T	P	Credit
34421C16	**HEAT AND MASS TRANSFER (Theory and Practicals)**	CC	2	1	2	4

Preamble

The purpose of this subject is to been able students understood different principles of heat transfer and its Extensive Engineering applications.

Prerequisite

ENGINEERING THERMODYNAMICS

Course Objectives

1	To enable students understand their conduction mechanism in steady state emphasizing on Application in engineering.
2	To enable students understand their conduction mechanism in unsteady state emphasizing on application in engineering.
3	To categorize various types of convection and its application.
4	To assess various concepts of radiation and its applications.
5	To enable students to understand Boiling, Condensation and Various types of Heat Exchangers.

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

CO1.	To assess the basic elements & various modes of heat transfer Used in Engineering applications.	Understand
CO2.	To solve the engineering problems using various methods of Transient heat conduction technologies	Apply
CO3.	To apply the concepts of convection systems in an engineering problem using standard values	Apply
CO4.	To choose the various concepts of radiation based on the requirements for the given problems	Apply
CO5.	To solve the engineering problems using Boiling, Condensation and heat transfer rate of heat exchangers using LMTD and NTU method	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO2	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO3	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO4	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-
CO5	S	M	L	L	-	-	-	S	S	S	-	-	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO HEAT TRANSFER AND STEADY STATE CONDUCTION

Heat transfer fundamentals; Basic heat transfer mechanisms (conduction, convection and radiation), Conduction -Introduction -Fourier law of conduction- General equation in Cartesian coordinates - One dimensional steady state conduction across Large plane wall, Long cylinder and Sphere- Composite wall – Composite cylinder – Composite sphere, Overall heat transfer coefficients, Critical Radius of insulation, Variable thermal conductivity, conduction with Heat generation, - Fins or extended

surfaces- Pin fins, annular fins, longitudinal fins, fins efficiency and fins effectiveness- Problems.

TRANSIENT HEAT CONDUCTION

Introduction – Lumped system analysis, semi – infinite solids. Transient Heat Conduction in Large Plane Walls, Long cylinders and Spheres. Significance of Biot and Fourier numbers, Transient heat transfer analysis of an infinite slab with specified temperature and connective boundary conditions. - Refrigeration and Freezing of Foods- Problems.

Use of Grover & Heisler charts for solving problems of infinite slabs, cylinders, spheres.

CONVECTION

Introduction – Physical Mechanism on Convection, Classification of Fluid Flows, Significance of non-dimensional numbers, Velocity Boundary Layer, Thermal Boundary Layer, Laminar and Turbulent Flows. External Forced convection – Flow over a Flat plate, cylinder, sphere and Tube Banks. Internal Forced Convection - Flow through pipes – annular spaces and noncircular conducts. Natural convection from vertical, inclined and horizontal surfaces.

RADIATION

Introduction – Thermal Radiation – Black body Radiation – Radiation Intensity- Radioactive Properties – Atmospheric and Solar Radiation – View Factor- Simple Problems- Black surfaces and Grey Surfaces – Net Radiation – Heat Transfer in Two and Three Surface Enclosures- Radiation Shield – Problems – Radiation Exchange with Emitting and Absorbing Gases.

BOILING, CONDENSATION AND HEAT EXCHANGERS

Boiling – Types of Boiling- Problems. Condensation – Types of Condensation- Problems.Heat Exchangers- Types- Overall heat transfer co-efficient- Analysis of Heat Exchangers – LMTD method – Effectiveness - NTU Method – Selection of Heat Exchangers – Problems.

LIST OF EXPERIMENTS

1. Determination of Thermal conductivity (Insulating Powder)
2. Determination of Emissivity
3. Determination of Heat transfer co-efficient through Forced Convection
4. Determination of Heat transfer co-efficient through Natural Convection
5. Determination of Heat transfer co-efficient of Pin-Fin Apparatus.
6. Determination of Stefan Boltzmann' s Constant
7. Determination of Thermal conductivity (Two Slabs Guarded Hot Plate Method)
8. Determination of Effectiveness of a Heat Exchanger By Parallel & Counter Flow
9. Determination of Thermal conductivity of the Composite wall.

Text Books

1. YUNUS A CENGEL "Heat Transfer"-Tata Mc Graw Hill–New Delhi.
2. KOTHANDARAMAN C.P "Fundamentals of Heat and Mass Transfer" New Age International.
3. SACHDEV R C -"Fundamentals of Engineering Heat and Mass Transfer" New Age International

Reference Books

1. OZISIKM.N- "Heat Transfer"-Tata Mc Graw-Hill Book Co.
2. NAGP.K-"Heat Transfer"-Tata Mc Graw-Hill-New Delhi.
3. HOLMAN J.P"Heat and Mass Transfer" Tata Mc Graw-Hill.
4. INCROPRA and DEWITE, Heat Transfer–John Wiley.

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration

1	Heat Transfer	Prof. Sunando DasGupta	IIT Kharagpur	12 weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	R.Anandan	Associate Professor	MECH/VMKVEC	anandan@vmkvec.edu.in
2	C.Thiagarajan	Associate Professor	MECH/AVIT	cthiagarajan@avit.ac.in

	FINITE ELEMENT ANALYSIS	**Category**	**L**	**T**	**P**	**Credit**
34421C14	**(Theory and Practicals)**	**CC**	**2**	**1**	**2**	**4**

Preamble

This course provides to learn the basic concepts of finite element analysis (FEA) of solids, structures, fluidsand its application in engineering.

Prerequisite

NIL

Course Objectives

1	Understand finite element analysis fundamentals and formulations.
2	Study the basics of element properties natural, Triangular & rectangular.
3	Formulation of finite element methods for Two and three-dimensional solids.
4	Formulate the truss, beam and frame problems.
5	Formulation of finite element methods for the analysis of heat transfer in solids.

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

CO1.	To understand the basic concepts of finite element analysis, node and node numbering methods.	Understand
CO2.	Derive the finite element equations for different mechanical elements. Natural, Triangular & rectangular elements	Apply
CO3.	Formulate and solve problems in 2-D& 3-D structural systemsof solids and their structures.	Apply
CO4.	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements	Apply
CO5.	To be able to conduct engineering analysis of basic heat conduction, structural mechanics problems use finite element methods.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO2	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO3	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO4	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**
CO5	**S**	**M**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**-**	**-**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO FINITE ELEMENT ANALYSIS

Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis. Finite Element Formulation Techniques, Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.

ELEMENT PROPERTIES

Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements. Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration – one dimensional, Numerical Integration: Two and Three Dimensional, Worked out Examples

FEM FOR TWO- AND THREE-DIMENSIONAL SOLIDS

Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements, Worked out Examples

ANALYSIS OF FRAME STRUCTURES

Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame.

STEADY STATE HEAT TRANSFER ANALYSIS

Basic equations of heat transfer, Axially loaded bar- Heat flow in a bar, Structure of FEA software package.Rate equation: conduction, convection, radiation, energy generated in solid

LIST OF EXPERIMENTS

1. Study of analysis and its benefits
2. Stress analysis of cantilever and simply supported beam
3. Application of distributed loads
4. Nonlinear analysis of cantilever beam
5. Buckling analysis
6. Stress analysis of axis-symmetry vessels
7. Static analysis of two-dimensional truss
8. Transient thermal conduction
9. Conductive heat transfer analysis
10. Plane stress bracket
11. Modal analysis of simply supported beam
12. Harmonic analysis of a cantilever beam

Text Books

1. Hutton, D.V., "Fundamentals of Finite Element Analysis", McGraw Hill, International Edition, 2004.
2. Segerlind, L.J., "Applied Finite Element Analysis", John Wiley & Sons, 1984.

Reference Books

1. Chandrupatla, T.R., Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice HallofIndia, 2002.
2. Zienkiewicz, O.C., "Finite Elements and Approximation", Dover International, 2006.
3. Cook R.D., Malkus, D.S., Plesha, M.E., Witt, R.J., "Concepts and Applications of Finite Element Analysis", 4thEdition, John Wiley & Sons, 2001.
4. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis - Theory and Application New York, McGraw-Hill

Alternative NPTEL/SWAYAM Course

S.No	NPTEL /SWAYAM Course Name	Instructor	Host Institution	Duration
1	Introduction to Finite Element Analysis	Prof.Nachiketa Tiwari,	IIT Kanpur	12 weeks

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.S.Prakash	Assistant Professor Gr II	MECH/ AVIT	prakash@avit.ac.in
2	J.Santhosh	Assistant Professor	MECH/VMKVEC	santhos@vmkvec.edu.in

PROGRAM ELECTIVE COURSES

		Category	L	T	P	Credit
34421P01	RENEWABLE SOURCES OF ENERGY	EC-PS	3	0	0	3

Preamble

Renewable source of energy are developing fast throughout the world, and their combination is increasingly able to meet the needs for available, agreeable, and affordable energy, also for the people that lack access to energy today. In addition, local energy resources are not hit by the high energy price increases that are threatening to reverse the progress in providing energy to the poor people that lack appropriate energy today. This is why sustainable energy, the combination of renewable energy and energy efficiency, is increasingly become a part of the efforts to reduce poverty.

Prerequisite

NIL

Course Objectives

1	To understand the importance of solar energy.
2	To learn the importance of wind energy.
3	To know the importance of bio energy.
4	To know various renewable energy power plants.
5	To learn the necessity of latest and modern energy sources.

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

CO1.	To apply the solar radiation, measurements of solar radiation and solar thermal collectors	Apply
CO2.	To apply wind data, energy estimation and wind energy conversion systems	Apply
CO3.	To apply the Biomass directs Combustion, Biomass gasifier and Biogas plant.	Apply
CO4.	To apply the Wave energy, Open and closed OTEC Cycles and Small hydro plant turbines	Apply
CO5.	To apply the power generation, transport, Fuel cells and its technologies	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO1	M	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	M	-	-	-	-	-	-	-	-	-	M	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	-	M	-	-
CO5	S	M	M	M	-	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

SOLAR ENERGY

Solar Radiation – Measurements of solar Radiation – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV applications.

WIND ENERGY

Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy-Generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

BIO – ENERGY

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct Combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – BioDiesel production and economics.

OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY

Tidal energy – Wave energy –Open and closed OTEC Cycles – Small hydro plant turbines – Geothermal energy sources- environmental issues.

NEW ENERGY SOURCES

Hydrogen generation, storage, transport and utilization, Applications - power generation- transport – Fuel cells – technologies, types – economics and the power generation.

Text Books

1	G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
2	S.P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi,1997.

Reference Books

1	Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996
2	Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 1986
3	G.N. Tiwari, "Solar Energy Fundamentals Design, Modelling and applications", Narosa Publishing House, New Delhi, 2002
4	L.L. Freris, "Wind Energy Conversion systems", Prentice Hall, UK, 1990

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Raja.s	Assistant Professor	MECH / VMKVEC	raja_slm3@yahoo.co.in
2	R.Mahesh	Assistant Professor -II	MECH / AVIT	mahesh@avit.ac.in

	ADVANCED IC	**Category**	**L**	**T**	**P**	**Credit**
34421P03	**ENGINES**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

On completion of this course, the students would be able to understand the operation, combustion, performance and emissions of internal combustion engines.

Prerequisite

NIL

Course Objectives

1	To study the construction and working of Spark Ignition Engines.
2	To study about the Compression Ignition Engines and Turbocharger.
3	To understand the different pollutants and its control techniques.
4	To study the different Alternative fuels available.
5	To study the various recent trends adopted in the field of automobiles.

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

CO1.	Understand the combustion aspects of SI Engines	Understand
CO2.	Understand the combustion aspects of CI Engines	Understand
CO3.	Distinguish the causes, effects and control of pollutants from an IC engine.	Understand
CO4.	Know the various alternate fuels, engine emissions, Measuring and Control techniques	Apply
CO5.	Illustrate the recent developments in Internal Combustion engines Include this	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	L	L	L	-	-	-	-	-	-	-	-	L	-	-
CO2	S	S	M	S	-	-	-	-	-	S	-	-	L	-	-
CO3	S	L	M		-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	L		-	-	-	-	-	-	-	-	L	-	-
CO5	S	S	M	L	-	-	-	-	-	-	-	L	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

SPARK IGNITION ENGINES

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection – Stages of combustion – Normal and Abnormal combustion – Knock – Factors affecting knock – Combustion chambers.

COMPRESSION IGNITION ENGINES

Diesel Fuel Injection Systems – Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion – Introduction to Turbocharging.

POLLUTANT FORMATION AND CONTROL

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission normsand Driving cycles.

ALTERNATIVE FUELS

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel – Properties, Suitability, Merits and Demerits – Engine Modifications.

RECENT TRENDS

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems – Hybrid Electric Vehicles – NOx Adsorbers – Onboard Diagnostics.

Text Books

1	Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2	Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.

Reference Books

1	Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2	Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987. 3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	Dr.S.Sangeetha	Associate Professor	MECH/ AVIT	sangeethas@avit.ac.in
2	R.Anandan	Associate Professor	MECH/VMKVEC	anandan@vmkvec.edu.in

		Category	L	T	P	Credit
34421P15	**INDUSTRIAL TRIBOLOGY**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

To present the engineering concepts of friction, its effects and different lubrication theories and types used in industries.

Prerequisite

NIL

Course Objectives

1	To understand the concept of tribology.
2	To examine the concepts of various types of wear.
3	To understand and apply the film lubrication theory.
4	To illustrate the various types of lubricants for different applications.
5	To demonstrate the various surface engineering concepts and bearing materials.

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

CO1.	Explain the concepts of friction, wear and lubrication	Understand
CO2.	Illustrate about the various types of wear, wear mechanism and its measurements	Apply
CO3.	Examine the various film lubrication theory	Apply
CO4.	Illustrate about the various types of lubricants	Apply
CO5.	Examine various surface modifications and bearing materials.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	-	-	-	-	-	-	-	-	-	M	-	L
CO2	S	M	L	-	-	L	-	-	-	-	-	-	M	-	L
CO3	S	M	L	-	-	L	-	-	-	-	-	-	M	-	L
CO4	S	S	M	M	-	L	-	-	-	-	-	-	M	-	L
CO5	S	S	S	M	-	L	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

SURFACES AND FRICTION

Introduction to the concept of tribology, Tribological problems- Nature of engineering surfaces, Surface topography- Surface profilometer, measurement of surface topography-Contact between surfaces, Sources of sliding Friction- Friction due to ploughing, Friction due to adhesion- Friction characteristics of metals and non-metals -Sources of rolling friction, Stick slip motion -Friction of ceramic materials and polymers- Measurement of friction.

WEAR

Wear and Types of Wear-Simple theory of sliding wear mechanism-Abrasive wear-Adhesive wear-Corrosive wear-Surface fatigue wear situations-Wear of ceramics-Wear of polymers-Wear measurements.

FILM LUBRICATION THEORY

Coefficient of viscosity, Fluid film in simple shear-Viscous flow between very close parallel plates:Tutorials-Lubricant supply, Lubricant flow rate-Cold jacking,Couette flow-Cavitations, Film rupture, oil whirl-Shear stress variation within the film-Lubrication theory by Osborne Reynolds: Tutorials-Pressure fields for full sommerfeld, Half sommerfeld-Reynolds boundary conditions.

LUBRICANTS AND LUBRICATION TYPES

Types of Lubricants-Properties of Lubricants-Testing methods-Hydrodynamic Lubrication-Elasto-hydrodynamic Lubrication-Hydrostatic lubrication

SURFACE ENGINEERING AND MATERIALS FOR BEARINGS

Classification of Surface modifications and Surface coatings-Surface modifications, Transformation hardening-Surface modifications, surface fusion-Thermo chemical Processes-Surface coatings -Materials for rolling element bearings- Materials for fluid film bearings-Materials for marginally lubricated and dry bearings.

Text Books

1	Tribology: priniciples and applications.
2	Williams.J.A, “Engineering Tribology”, Oxford University Press.
3	GwidonStachowiak, Andrew W Batchelor., “Engineering tribology”, Elsevier Butterworth –Heinemann, USA.

Reference Books

1	Industrial Tribology: Tribosystems, Friction, Wear and Surface Engineering, Lubrication Hardcover , by Theo Mang, Kirsten Bobzin, Thorsten Bartels
2	meron.A, “Basic Lubrication Theory”, Longman, U.K.
3	ale.M.J. (Editor), “Tribology Handbook”, Newnes Butter worth, Heinemann, U.K.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/Name of the College**	**Email id**
1	M.Saravanan	Asst Prof	MECH./ AVIT	saravanan@avit.ac.in
2	J.Satheesbabu	Asso Prof	MECH./ VMKVEC	satheesbabu@vmkvec.edu.in

		Category	L	T	P	Credit
34421P16	LEAN MANUFACTURING SYSTEMS	EC-PS	3	0	0	3

Preamble

This course provides basic knowledge in various tools and techniques in lean manufacturing systems.

Prerequisite

NIL

Course Objectives

1	To gain the knowledge and understanding the basic concepts of lean manufacturing process.
2	To understand the various quality improvement methods in lean manufacturing.
3	To learn the basic concepts of JIT and VSM.
4	To analyse the importance of JIDOKA and its role.
5	To understand the importance of employee involvement and systematic planning.

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

CO1.	Remember and understand the Principles, basic concepts in lean manufacturing.	Understand
CO2.	Understand, analyze and design a suitable method for quality improvement	Analyze
CO3.	Understand the JIT methodology, Kanban rules and the importance of defining value.	Apply
CO4.	Understand and Analyze the importance of Jidoka and the implementation	Analyze
CO5.	Learn the requirement of employee involvement in the implementation of lean culture.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	S	L	S	L	-	-	-	-	-	-	M	-	-
CO2	M	L	S	L	S	L	-	-	-	-	-	-	M	-	-
CO3	M	L	S	L	S	L	-	-	S	-	-	-	S	-	-
CO4	M	L	S	L	S	L	-	-	S	-	-	-	S	-	-
CO5	M	L	S	L	S	L	-	L	S	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Objectives of lean manufacturing-key principles -- traditional Vs lean manufacturing-Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

STABILITY OF LEAN SYSTEM

Standards in the lean system–5S system–Total Productive Maintenance–standardized work–Elements of standardized work–Charts to define standardized work–Man power reduction–Overall efficiency–standardized work and Kaizen–Common layouts.

JUST IN TIME

Introduction - JIT system-Principles and elements of JIT – Kanban rules – Expanded role of conveyance

– Production leveling – Pull and Push systems – Process Mapping and Value stream mapping

JIDOKA (AUTOMATION WITH A HUMAN TOUCH)

Jidoka concept – Poka-Yoke (mistake proofing) systems – Inspection systems and zone control – Types and use of Poka-Yoke systems – Implementation of Jidoka.

WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture

Text Books

1	Pascal Dennis, Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, (Second edition), Productivity Press,New York.
2	Mike Rother and John Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, Lean Enterprise Institute.

Reference Books

1	Jeffrey Liker, the Toyota Way: Fourteen Management Principles from the World's Greatest Manufacturer, McGraw Hill.
2	Michael L. George, Lean Six SIGMA: Combining Six SIGMA Qualities with Lean Production Speed, McGraw Hill.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**
1	J.Senthil	Associate Professor	MECH/AVIT	jsenthil@avit.ac.in
2	S.Duraithilagar	Associate Professor	MECH/VMKVEC	duraithilagar@vmkvec.edu.in

		Category	L	T	P	Credit
34421P13	**INDUSTRIAL ENGINEERING**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

This course deals with productivity measurements, method study techniques, work measurement, production planning and control and industrial Legislation.

Prerequisite

NIL

Course Objectives

1	To understand the importance of work study methods and its importance in various fields.
2	To develop the skills of selection of a plant and also material handling equipment required.
3	To learn PPC and its functions.
4	To learn the skills of purchasing materials and their management.
5	To learn the awareness on various labour acts and management principles.

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

CO1.	Evaluate the work methods through work measurement	Understand
CO2.	Establish the efficient work system	Apply
CO3.	Identify the suitable forecasting techniques for given applications	Apply
CO4.	Prepare the charts, diagrams and production plan.	Apply
CO5.	Describe the theory in industrial engineering and their applications.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	M	L	S	-	-	-	-	-	-	-	M	-	S
CO4	S	M	M	L	-	-	-	-	-	-	-	-	M	-	M
CO5	S	S	S	S	S	-	-	-	S	M	-	-	S	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

WORK MEASUREMENT AND WORK STUDY

Evolution and importance of industrial engineering–Production-Classification-Productivity-Factors influencing productivity-quality route to productivity- Introduction to Work measurement and its Techniques-Work study-Definition-Procedure and benefits of work study-Charting techniques-Time study-Stop watch time study-Motion study-Work sampling procedure-collection of data-Method study.

PLANT LAYOUT AND MATERIAL HANDLING

Plant location and site location-factors influencing the location-Plant layout-Types, needs, factors influencing the plant layout-Plant layout procedure-Material handling-scope and principles of material handling-Types of Material Handling equipment-Factors influencing material handling-Methods of material handling.

PRODUCTION PLANNING AND CONTROL

Introduction-Objectives and Functions of PPC-Forecasting-Sales Forecasting Techniques-Types of Forecasting-Routing-Objectives and procedure of routing-Scheduling-Master Production Schedule- purpose and preparation of schedules-Scheduling techniques like CPM and PERT-Dispatching-Dispatch Procedure-Centralized and Decentralized dispatching-Tool dispatching

MATERIAL MANAGEMENT

Procurement of materials-codification of materials-Inventory control-Objectives of inventory control-EBQ & EOQ values-Inventory models-ABC analysis-Material requirements planning(MRP)-Enterprise resource planning(ERP)-supply chain management(SCM)-Inspection and quality control-SQC-control charts-Sampling procedures-Benchmarking

INDUSTRIAL LEGISLATION AND MANAGEMENT CONCEPTS9 Hours

Importance and necessity of labour acts-principles of labour legislation-various acts-Industrial Ownership and various types-Functions of management-Manpower Planning-Recruitment and Selection-Break EvenAnalysis-Managerial applications of breakeven point-Decision making - Techniques of decision making.

Text Books:

1	Khan, M.I, "**Industrial Engineering**", New Age International, 2nd Edition, 2009.
2	Kapoor N.D, "**Handbook of Industrial Law**", sultan Chand & sons, 14th revised edition 2013.

Reference Books:

1	Khanna, O.P, "**Industrial Engineering and Management**", Dhanpat Rai and Sons, 2008.
2	Samuel Eilon, "**Elements of Production Planning and Control**", Universal Publishing Corporation, Bombay, 1994.
3	Panneerselvam R, "**Production and Operations Management**", PHI, New Delhi, 2006.

Course Designers

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		Category	L	T	P	Credit
34421P12	HYDRAULICS AND PNEUMATIC SYSTEMS	EC-PS	3	0	0	3

PREAMBLE

Today, Industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production and reduced costs. The controlling parameters like motion, Speed, Position and torque are paramount in raising productivity and quality and reducing energy and equipment costs in all industries. Electric drives share most of industrial machine control applications. The variable speed drives which controls speed of a.c/d.c motors are indispensable controlling elements in automation systems. Such drives contain various high performance motors, power electronic converters and digital control systems. With wide options which are open to engineers for selecting proper drive system, one can look forward for a highly efficient and reliable drive for every application in industry.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To understand about basics of fluid power systems fundamentals.
2	To acquire knowledge about components used in hydraulic and pneumatic systems.
3	To familiarize about the various types of valves and actuators.
4	To design hydraulic circuits for different applications.
5	To design pneumatic circuits for different applications.

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

CO1. Understand the different drive systems and identify which is suitable for specific application.	Understand
CO2. Understand the working of different components in fluid power system.	Understand
CO3. Understand about the utilization of cylinders, accumulators, valves and various control components.	Understand
CO4. Design a feasible hydraulic circuit for a given application.	Apply
CO5. Design a feasible pneumatic circuit for a given application.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	S	M	M	L	M	-	-	-	-	-	-	-	L	-	-
CO2	S	M	M	L	M	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	L	M	-	-	-	-	-	-	-	L	-	-
CO4	S	S	S	M	L	M	-	-	-	-	-	-	L	-	-
CO5	S	S	S	M	L	M	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

FLUID POWER SYSTEMS AND FUNDAMENTALS

Introduction to fluid power, Advantages and Applications of fluid power system. Basic Laws in Fluid power system, Types of fluid power systems, Properties of fluids – General types of fluids – Fluid power symbols. Basic Laws in Fluid power system. Low cost automation.

HYDRAULIC SYSTEM & PNEUMATIC SYSTEMS COMPONENTS

Pump classification – Gear pump, Vane Pump, Piston pump, construction and working of pumps– Variable displacement pumps. Pneumatic Components: Compressors-types. Filter, Regulator, Lubricator Unit, Muffler

VALVES AND ACTUATORS

Construction of Control Components: Director control valve – 3/2 way valve ,4/2 way valve, Shuttle valve, check valve – pressure control valve –pressure reducing valve, sequence valve-Flow control valve.. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like Telescopic, Cushioning mechanism, Construction of single acting and double acting cylinder.

DESIGN OF HYDRAULIC CIRCUITS

Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, intensifier – Intensifier circuit. Circuits: Reciprocating- Regenerative - Quick return – Sequencing – Synchronizing - Safety circuits -Press – Planer.

DESIGN OF PNEUMATIC CIRCUITS

Fluid Power Circuit Design: Speed control circuits, synchronizing circuit, Sequential circuit design for two and three cylinder using cascade method. Pneumo-hydraulic circuit. Electro pneumatic circuit, Fluid power circuits- failure and troubleshooting.

Text Books:

1. Anthony Esposito - “Fluid Power with Applications”- Pearson Education - 2013
2. Srinivasan - “Hydraulic and Pneumatic Controls”- TMH - 2011.
3. Andrew Parr - “Hydraulics and Pneumatics "- Jaico Publishing House

Reference Books:

1. Thomson, “Introduction to Fluid power”- Prentice Hall - 2004.
2. Majumdar S.R. - “Oil Hydraulics – Principles and maintenance”- Tata McGraw-Hill.
3. Majumdar S.R. - “Pneumatic systems – Principles and maintenance”- Tata McGraw Hill.

Course Designers

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		Category	L	T	P	Credit
34421P09	**FAILURE ANALYSIS OF MATERIALS**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

This course covers failures of materials and causes of failure, topics include types of failure in components and equipments for failure analysis.

Prerequisite

NIL

Course Objectives

1	To study the fundamentals of failure analysis.
2	To study introduction to failure analysis.
3	To study the causes of failure in components.
4	To study the types of failure in components.
5	To study the methods and equipments for failure analysis.

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

CO1.	Apply the importance of failure analysis for automotive components and Determination of failure mode.	Apply
CO2.	Identify the failure mode identification methods andCorrosion failures.	Apply
CO3.	Explain the causes of failure in components.	Understand
CO4.	Summarize the types of failures in components.	Understand
CO5.	Indentify the methods and equipments for failure analysis.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	M	-	-	M	-	-	-	-	-	-	L	-	-
CO2	S	M	M	-	-	L	-	-	-	-	-	-	L	-	-
CO3	S	M	M	-	-	M	-	-	-	-	-	-	L	-	-
CO4	S	L	L	-	-	L	-	-	-	-	-	-	L	-	-
CO5	S	M	M	-	-	L	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF FAILURE ANALYSIS

Importance of failure analysis for automotive components, Steps in typical failure analysis: Collection of background data (review documentation and speak with appropriate individuals), Selection of failed and un failed samples for examination, Preliminary examination of the failed part, Non-destructive evaluation, Mechanical testing, Macroscopic examination and analysis, Microscopic examination and analysis, Determination of failure mode, Chemical analysis, Fracture mechanics considerations, Full scale testing under service conditions, Analysis of the evidence, Formulation of conclusions, Recommendations to prevent reoccurrence, Sample preparation methods for failure analysis, Selection of locations/samples
For failure analysis.

INTRODUCTION TO FAILURE ANALYSIS

Failure mode identification methods, Failure mechanisms: Fatigue failures, fractography, effect of variables: part shape, type of loading, stress concentration, metallurgical factors, etc. Wear failures, adhesive, abrasive, erosive, corrosive wear. Corrosion failures, types of corrosion: uniform, pitting, selective leaching,
intergranular, crevice, etc. Elevated temperature failures, creep, thermal fatigue, micro structural instability, and oxidation.

CAUSES OF FAILURE IN COMPONENTS

Misuse or Abuse, Assembly errors, Manufacturing defects, Improper maintenance, Fastener failure, Design errors, Improper material, Improper heat treatments, Unforeseen operating conditions, Inadequate quality assurance, Inadequate environmental protection/control, Casting discontinuities. Data compilation and identification of root cause.

TYPES OF FAILURES IN COMPONENTS

Fatigue failures, Corrosion failures, Stress corrosion cracking, Ductile and brittle fractures, Hydrogen embrittlement, Liquid metal embrittlement, Creep and stress rupture.

METHODS AND EQUIPMENTS FOR FAILURE ANALYSIS

Selection of suitable testing methods for failure analysis, Selection of metallurgical equipments for Failure Analysis, SEM-EDAX.

Text Books

1	"Understanding How Components Fail" by Donald J. Wulpi; ASM International Publication.
2	"Analysis of Metallurgical Failures: by Vito J. Colangelo; Francis A. Heiser Wiley Publication
3	ASM Handbook Vol.11 - Failure Analysis and Prevention, ASM International Publication, 1995.

Reference Books

1	"Metallurgy of Failure Analysis" by A K. Das; by McGraw-Hill Professional Publication.
2	Metallurgical Failure Analysis by Charlie R. Brooks; Ashok Choudury; McGraw-Hill Publication.

Course Designers

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34421P11	FUNDAMENTALS OF PIPING ENGINEERING	Category	L	T	P	Credit
		EC-PS	3	0	0	3

Preamble:
The students completing this course are expected to gain knowledge on fundamentals of piping engineering, pipe hydraulics, piping supports and design.

Prerequisite

NIL

Course Objectives

1	To understand the importance of piping engineering.
2	To enable student to learn the application of flanges and valves.
3	To understand about process mechanical equipments.
4	To gain knowledge about various pipe supports.
5	To enable students to learn about various types of stress analysis.

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

CO1.	Discuss the basic concepts of piping engineering.	Understand
CO2.	Discuss the application of flanges and valves.	Understand
CO3.	Apply the concept of various process mechanical equipments.	Apply
CO4.	To gain knowledge about various pipe supports.	Apply
CO5.	Analyze the different types of stress.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO4	S	S	M	L	-	-	-	-	-	M	-	-	M	-	-
CO5	S	S	S	M	S	-	-	-	-	S	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Introduction to Piping Responsibilities of Piping Engineer and Designer - Scope of Piping Input and Outputs - General: Process Diagrams (PFD, UFD, P&ID, Line List etc) - Piping Fundamentals Definition, Application Codes and Standards.

FLANGES AND VALVES

Introduction to Flanges and Valves – Application and advantages of Flanges - Pipe Fittings - Pipe Flanges – Valves -Piping Special Items

PROCESS MECHANICAL EQUIPMENTS

Process Mechanical Equipments – Static equipments & Rotary equipments
Layouts - Preparation of Plot Plan - Preparation of Equipment Layouts - Preparation of Piping General Arrangement Drawings - Preparation of Cross Sectional Drawings - Piping Isometric Drawings & Material Take off

PIPE SUPPORTS

Pipe Supports: Support Types - Support Selection, Support Location, Support Span Calculation - Typical Unit Conversion - Materials: Preparation of Piping Material Specification - Valve Material Specification - Familiarity with ASME B31.3 Pipe Wall thickness Calculations.

STRESS ANALYSIS

Preparation of Special Items Datasheets: Pressure Design of Miter Bends – Single & Multiple Miters - Pressure Design of Blanks - Branch reinforcement calculations - Overview of Technical Queries and Technical Bid Evaluations
Stress Analysis: Types of stresses, Significance of forces and moments - Introduction to Stress Analysis - Expansion Loop types, Bellows Types

Text Books

1	G.K.Sahu, Fundamentals of piping design, New Age International Publishers

Reference Books

1	Peter Smith, R.W.Zappe, Valve Selection Hand Book, Elsevier Science
2	Peter Smith, The fundamentals of piping design, Elsevier Science

Course Designers

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1	M.Saravanan	Assistant Professor	MECH/AVIT	saravanan@avit.ac.in
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	CONCURRENT	**Category**	**L**	**T**	**P**	**Credit**
34421P04	**ENGINEERING**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

This course reviews the benefits of Concurrent engineering, life cycle product design, design as per customer requirements, different manufacturing methods with computer based approach, importance of quality during product design, reliability, maintainability and economics of product design.

Prerequisite

NIL

Course Objectives

1	Study the benefits of concurrent engineering, life-cycle design of the products, structure and organization and implementation process of the CE.
2	Learn about the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.
3	Study the role of design for manufacturing in concurrent engineering, different DFM methods, creative design methods and computer based approach to DFM.
4	Learn about the importance of quality during the product design and methods used to evaluate the quality.
5	Learn about the design of the product for reliability, maintainability and economics.

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

CO1.	Know the meaning, objectives and benefits of the concurrent engineering, life-cycle design of the products, structure and organization and implementation process of the CE.	Understand
CO2.	Understand the design of the product as per the customer requirements and also understand the co-operation/ coordination required between the different departments like marketing, design and the latest softwares available so far.	Understand
CO3.	Understand the role of design for manufacturing in concurrent engineering, different DFM methods, creative design methods and computer based approach to DFM.	Understand
CO4.	Know the importance of quality during the product design and methods used to evaluate the quality.	Understand
CO5.	Understand the design of the product for reliability, maintainability and economics.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	S	L	L	--	-	-	-	-	-	-	L	-	-
CO2	S	M	S	S	S	M	-	-	-	-	-	-	S	-	-
CO3	S	M	S	L	M	M	-	-	-	-	-	-	M	-	-
CO4	S	M	S	S	M	M	-	-	-	-	-	-	M	-	-
CO5	S	L	S	M	L	--	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION:

Sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. SUPPORT FOR CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

DESIGN PRODUCT FOR CUSTOMER

Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent engineering design- Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns.

DESIGN FOR MANUFACTURE (DFM)

Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assembliability.

QUALITY BY DESIGN

Quality engineering & methodology for robust product design, parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

DESIGN FOR X-ABILITY

Design for reliability, life cycle serviceability design, design for maintainability, design for economics, decomposition in concurrent design, concurrent design case studies.

Text Books

1	Concurrent Engineering- Kusiak - John Wiley & Sons
2	Concurrent Engineering- Menon - Chapman & Hall

Reference Books

1	Integrated Product Development/Anderson MM and Hein, L.Berlin, Springer Verlog,1987.
2	Design for Concurrent Engineering/ Cleetus, J. Concurrent Engg. Research Centre, Morgantown, WV, 1992.

Course Designers

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34421P08	ENGINEERING PRODUCT DESIGN	Category	L	T	P	Credit
		EC-PS	3	0	0	3

Preamble

Engineering Product Design is a challenging, rewarding activity that requires multifunctional cooperation and inter-disciplinary skills.

Prerequisite

NIL

Course Objectives

1	To understand the models in developing new engineering products.
2	To learn how to identify the customer needs and integrate the end-consumer into process.
3	To learn and apply the concepts and tools necessary for concept generation and evaluation.
4	To apply embodiment design concept in the process of new product development.
5	To Understand the concept of manufacturing process and design the product accordingly.

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

CO1.	Understand the conceptual development techniques to find solution for a critical design issue.	Understand
CO2.	Apply embodiment principles to translate the conceptual ideas to engineering design.	Understand
CO3.	Apply environmental, ethical and social issues during innovative design process.	Apply
CO4.	Design and develop innovative engineering products for industrial needs using robust design philosophy.	Apply
CO5.	Apply the concept of Design for Manufacture and to understand the different modes of Failure of the product.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	L	L	-	-	-	-	-	-	-	M	-	-
CO2	M	L	L	L	L	-	-	-	-	-	-	-	M	-	-
CO3	S	S	S	S	S	-	-	-	-	-	-	-	S	-	-
CO4	S	M	M	M	M	-	-	-	-	-	-	-	M	-	-
CO5	S	S	S	S	S	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Innovations in Design, Engineering Design Process, Prescriptive and integrative models of design,Design Review and societal considerations.

IDENTIFICATION OF CUSTOMER NEED

Evaluating Customer requirements and survey on customer needs, Conversion of customer needsinto technical Specifications, Information sources.

CONCEPT GENERATION AND EVALUATION

Creativity and Problem solving, Brainstorming, Theory of Inventive Problem solving (TRIZ), Functional Decomposition of the problem for innovative concept development, Morphological design, Introduction to Axiomatic Design, Concept evaluation and decision making.

EMBODIMENT DESIGN

Introduction, Product Architecture, Configuration and Parametric design Concepts, Industrial Design.

DESIGN FOR MANUFACTURING

Design for Manufacturing, Design for Assembly, Design for Environment, Design for Reliabilityand Robustness, Introduction to FMEA.

Text Books

1	Nigel Cross, Engineering Design Methods, John Wiley, 2009.

Reference Books

1	George E. Dieter, Engineering Design, McGraw-Hill, 2009.
2	Genrich Altshuller, The Innovation Algorithm, Technical Innovation Centre, 20LL.

Course Designers

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		Category	L	T	P	Credit
34421P07	**DESIGN OF EXPERIMENTS**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

This course that deals with two of the most important approaches to collecting research data experiments. To enable the students to understand the various statistical tools & Problem solving techniques.

Prerequisite

NIL

Course Objectives

1	Know about Design of Experiment.
2	Understand the methodology for Design of Experiment.
3	Familiarize about concepts of confounding and ANOVA.
4	Expose the concepts of response surface design.
5	To apply Taguchi method.

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

CO1.	Understand the principles and theory of designing experiments.	Understand
CO2.	Apply basic principles in the design of simple experiments.	Apply
CO3.	Understand and use the terminology of experimental designs.	Understand
CO4.	Select and design an appropriate method of data collection for a research project.	Analyze
CO5.	Apply the concept toproduct design and development for obtain optimum results.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	M	S	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	S	-	-	-	-	-	-	-	-	S	-	-
CO3	S	S	S	M	S	-	-	-	-	-	-	-	M	-	-
CO4	M	S	M	M	M	L	-	-	-	-	-	-	M	-	-
CO5	M	M	L	M	L	M	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

BASICS OF DESIGN OF EXPERIMENTS

Introduction in Design of experiments (DOE) - Fundamental and practical issue in industrial experimentation - Statistical thinking and its role within DOE - Basic principles of DOE and Degrees of freedom - Selection of quality characteristics for industrial experiments - Understanding key interaction in processes - Alternative method for calculating two-order interaction effect - Synergistic interaction versus Antagonistic interaction

METHODOLOGY FOR DESIGN OF EXPERIMENTS

DOE methodology - Barriers in the successful application of DOE - Practical methodology of DOE and Analytical tools for DOE - Confidence interval for the mean response - Introduction of Screening design - Geometric and non-geometric P-B design - Introduction of full factorial design - 2^2 , 2^3 ,2^4 full factorial design

CONFOUNDING

Introduction and uses of confounding - 2^3 factorial experiment with complete confounding -2^3 factorial experiment with partial confounding - Confounding in the 2^n series and examples - Confounding of 3^2 factorial - Confounding of 3^3 factorial and examples - Mixed series and examples - Introduction on ANOVA Analysis

RESPONSE SURFACE DESIGN

Background of response surface design - Creation of response surface design - Central composite design - Box Behnken design - Contour profile of response surface plot - Design table - Analyze the data - Case studies on response surface design - Experiment with random factor

TAGUCHI METHOD

Taguchi design approach - Orthogonal array, S/N ratio - Smaller is better, Nominal is better and larger is better with simple case studies - Analyze the data, factor effect diagram - Levels of parameters - Confirmation test - Augmented design with simple case studies.

Text Books

1	Jijuantony, "Design of Experiments for Engineers and Scientists", Elsevier.
2	Douglas C Montgomery, " Design and Analysis of Experiments" , John Wiley & Sons Ltd.

Reference Books

1	1. M N Das, N C Giri, “Design and Analysis of Experiments", New Age International (P) Limited, Publishers, 1997.
2	Larry B. Barrentine, “An introduction to Design of Experiments A simplified approach”, New Age International Publishers, 2010.
3	William G. Cochran, Gertrude M. Cox, “Experimental Design", John Wiley and sons, Inc.
4	Cox C.R, “The theory of Design of Experiments", Chapman and Hall, CRC Press.

Course Designers

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		Category	L	T	P	Credit
34421P10	**FLUID POWER SYSTEMS**	**EC-PS**	**3**	**0**	**0**	**3**

Preamble

Fluid Power is the technology that deals with the generation, control, and transmission of power, using pressurized fluids. Fluid power is called hydraulics when the fluid is a liquid and is called pneumatics when the fluid is a gas. Hydraulic systems use liquids such as petroleum oils, synthetic oils, and water. Pneumatic systems use air as the gas medium because air is very abundant and can be readily exhausted into the atmosphere after completing its assigned task.

Prerequisite

NIL

Course Objectives

1	To study about the principles of main hydraulic and pneumatic components.
2	To design and study about the principles of main pneumatic components.
3	To learn the methodology of circuit diagram.
4	To design and study about the principles of electro-pneumatic and hydraulic circuits.
5	To study and analyze various circuits application ,maintenance and safety aspects.

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

CO1.	Explain the principles of main hydraulic and pneumatic components. static and dynamic performance characteristics design of component	Understand
CO2.	Explain the principles of main pneumatic components. static and dynamic performance characteristics design of component	Apply
CO3.	Students are able to read the circuit diagrams methodology and to understand the principles of circuit operation, in relation to the performance of the individual components themselves.	Apply
CO4.	Explain the design of electro-pneumatic and hydraulic circuits.	Apply
CO5.	Students are able to design of hydraulic and pneumatic circuits applied to machine tools. Maintenance and safety aspects .	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	S	S	-	-	-	-	-	-	-	M	-	-
CO2	M	S	M	M	S	-	-	-	-	-	-	-	L	-	-
CO3	S	M	M	M	L	-	-	-	-	-	-	-	M	-	-
CO4	M	L	S	L	S	-	-	-	-	-	-	-	M	-	-
CO5	S	M	L	M	M	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

HYDRAULIC COMPONENTS

Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps-Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.

PNEUMATIC COMPONENTS

Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.

FLUID POWER CIRCUITS

Circuit Design Methodology-Sequencing circuits-Overlapping signals-Cascade method-KV Map method-Industrial Hydraulic circuits-Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits-Accumulator circuits.

ELECTRO - PNUEMATICS AND HYDRAULICS

Relay, Switches-Solenoid-Solenoid operated valves-Timer-Counter-Servo and proportional control-Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.

APPLICATION, MAINTENANCE AND TROUBLE SHOOTING

Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation- Maintenance and trouble shooting of Fluid Power circuits-Safety aspects involved.

Text Books

1	Anthony "Esposito, Fluid Power with applications", Prentice Hall international–1997.
2	Majumdar.S.R, "Oil Hydraulics", Tata McGraw Hill, 2002.
3	Majumdar S.R, "Pneumatic systems-principles and maintenance", Tata McGraw Hill 1995.

Reference Books

1	John Pippenger, Tyler "Hicks, Industrial Hydraulics", McGraw Hill International Edition, 1980.
2	Andrew Parr, "Hydraulics and pneumatics", Jaico Publishing House, 2003.
3	FESTO, "Fundamentals of Pneumatics", Vol I, II, III.

Course Designers

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		Category	L	T	P	C
34421P17	**MEMS AND NEMS**	**EC-PS**	**3**	**0**	**0**	**3**

PREAMBLE

The course reviews the various applications of MEMS AND NEMS and its applications in sensors and actuators.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To study the fundamentals of MEMS and NEMS.
2	To gain knowledge on fabrication of MEMS.
3	To study on Micro Sensors.
4	To study on Micro actuators.
5	To study on Nano systems and Quantum Mechanics.

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

CO1.The student will understand the various applications of NEMS and MEMS	Understand
CO2. The student will understand the Various fabrication of MEMS	Understand
CO3. The student will learn the working of various micro sensors	Analyze
CO4. The student will know how to design the working of micro actuators	Apply
CO5. The student will understand the nanosystems and quantum mechanics	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	S	S	L	L	-	-	-	-	-	-	-	S	-	-
CO4	S	S	S	L	L	-	-	-	-	-	-	-	M	-	-
CO5	S	M	M	M	S	-	-	-	-	-	-	-	M	-	-

S- Strong M-Medium L- Low

SYLLABUS

OVERVIEW AND INTRODUCTION

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of

Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals
MEMS FABRICATION TECHNOLOGIES
Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials
MICRO SENSORS
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope,Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Micro sensors. Case study: Piezo-resistive pressure sensor
MICRO ACTUATORS
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators
NANOSYSTEMS AND QUANTUM MECHANICS
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.
Text Books:
1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press. 2. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers.
Reference:
1. Tai Ran Hsu , “MEMS and Microsystems Design and Manufacture” ,Tata McGraw Hill. 2. Chang Liu, “Foundations of MEMS”, Pearson education India limited.

Course Designers

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		Category	L	T	P	Credit
34421P19	PETROLEUM PRODUCTION ENGINEERING	EC-PS	3	0	0	3

Preamble:
The students completing this course are expected to gain knowledge on oil well drilling engineering and operations and fundamentals equations and calculations used in drilling engineering.

Prerequisite

NIL

Course Objectives

1	To understand oil well drilling engineering and operations.
2	To get familiarized with field equipment practices, difficulties and actions to be taken.
3	To learn fundamental equations and calculations used in drilling engineering.
4	To gain knowledge about casing and cementation.
5	To enable students to analysis various drilling fluids.

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

CO1.	Discuss the basic concepts of well drilling engineering	Understand
CO2.	Apply the concept of fundamental equations and calculations used in drilling engineering.	Apply
CO3.	To gain knowledge about Casing and cementation	Apply
CO4.	Apply the concept of using of drilling fluids	Apply
CO6	Analyze the different drilling fluids	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	M	-	M
CO3	S	S	M	L	-	-	-	-	-	M	-	-	M	-	M
CO4	S	S	S	M	-	-	-	-	-	M	-	-	L	-	L
CO5	S	S	S	M	S	-	-	-	-	S	-	-	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

DRILLING RIG

Rotary / top drive drilling for oil and natural gas, introduction to hardware system, power generation system, Hoisting, Rotary and drilling fluid circulation system, Rig selection, onshore offshore rigs, onshore and offshore drilling operations, Horse power calculations for draw-works and rotary advantages and disadvantages of top drive system.

DRILLING OPERATIONS AND DIFFICULTIES

Down hole drilling problems and solutions, factors affecting rate of penetration, drill off test, bit section, IADC classification of bit, dull bit gradation, circulation system, mud pumps, numerical related to mud pumps of circulation system, problems concerned with drilling fluid and drill pipe stuck up, geometry of a stuck pipe. Hole problems (lost circulation, kick etc) well control equipment BOP.

DRILLING TECHNIQUES AND FISHING

Introduction to directional, horizontal multilateral drilling techniques. Types of well, coring operations, Fishing tools and operations. Terminology used in directional wells and basic mathematics used in directional wells (DMS to Dec. Deg, co-ordinate system).

CASING AND CEMENTATION

Casing and Cementation, Functions, types, API grades properties of casing, Threads and couplings, Functions, classification of cement, Strength retrogenion, Cement additives, Methods of cementation, Equipment accessories, Field problems pertaining to cementation job, Cement slurry calculations.

DRILLING FLUIDS

Drilling fluid, Functions, Types, compositions, Properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipments, Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling.

Text Books

1	Gatlin C.; Petroleum Engineering, Drilling and Well Completions, Prentice Hall.

Reference Books

1	Rabia H.; Oil Well Drilling Engineering, Graham Trotman Ltd., London.
2	Azar, J. J., G. Robello Samuel; Drilling Engineering, Penn Well.

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INDUSTRY OFFERED/ INDUSTRY SUPPORTED COURSES

		Category	L	T	P	Credit
34421I01	INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS	EC-IE	3	0	0	3

Preamble

To provide knowledge about stakeholders in aviation industries and employment skills required by companies.

Prerequisite

NIL

Course Objectives

1	To provide an understanding of the basics of aircrafts.
2	To provide a deep knowledge of stakeholders in aviation industries.
3	To develop analytical skills for taking decisions.
4	To develop criticizing skills and compare for better and best.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of an aircraft.	Remember
CO2.	Explain working of components of aircraft and its systems.	Understand
CO3.	Employ analytical skills for judgement of best.	Apply
CO4.	Categorise knowledge gained and will be able to apply suitably.	Analyze
CO5.	Evaluate and balanced approach towards employment in industries.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	AIRCRAFT INDUSTRY OVERVIEW	8

Evolution and History of Flight, Types of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario.

UNIT – II	INTRODUCTION TO AIRCRAFTS	8

Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices. Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.

UNIT – III	INTRODUCTION TO AIRCRAFT SYSTEMS	9

Types of Aircraft Systems, Mechanical Systems, Electrical and Electronic Systems, Auxiliary systems, Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit, Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System.

UNIT – IV	BASIC PRINCIPLES OF FLIGHT	10

Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects. Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag.

UNIT – V	BASICS OF FLIGHT MECHANICS	10

Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects

Stability and Control

Degree of Stability- Lateral, Longitudinal and Directional Stability and controls of Aircraft. Effects of Flaps and Slats on Lift Coefficients, Control Tabs, Stalling, Landing, Gliding Turning, Speed of Sound, Mach Numbers, Shock Waves

Aircraft Performance and Maneuvers

Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on an Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability.

TEXT BOOK:

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition.
2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition.
3. Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition.

REFERENCES:

1. Introduction to Flight by Dave Anderson.
2. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian Moir, Allan Seabridge
3. An Introduction to Aircraft Certification; A Guide to Understanding JAA, EASA and FAA by Filippo De Florio, Butterworth-Heinemann.

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		Category	L	T	P	Credit
34121I11	DESIGN OF AIRCRAFT STRUCTURES	EC-IE	3	0	0	3

Preamble

To study about load taking capabilities of components of aircraft structures.

Prerequisite

NIL

Course Objectives

1	To understand the basic concepts of strengthening components of aircrafts.
2	To develop an understanding of applications of basic theories of strength of materials.
3	To develop analytical skills for selection of suitable and precise method.
4	To design and suggest modification in existing load carrying members.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and label components of aircraft structures.	Remember
CO2.	Explain working of load carrying members.	Understand
CO3.	Employ analytical skills to calculate stresses at different points.	Apply
CO4.	Categorise the structure and estimate reliable performance.	Analyze
CO5.	Evaluate and modify the system for meeting suitable requirement.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3	S	S	S	S	-	-	-	-	-	S	-	-	M	M	M
CO4	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5	S	S	S	S	-	-	-	-	-	-	S	-	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS		
UNIT – I	**FUNDAMENTALS OF AIRCRAFT DESIGN PROCESS AND STRUCTURAL ANALYSIS**	**8**
Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies, Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St. Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations.		

UNIT – II	**INTRODUCTION TO AIRCRAFT STRUCTURES AND AIRCRAFT LOADS**	**9**
Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints, Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads.		
UNIT – III	**AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES**	**8**
Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Super-plastic Forming And Diffusion Bonding		
UNIT – IV	**STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES**	**12**
Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. **Sample Exercises**. Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, **Sample exercises** Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. **Sample Exercises**. Theory of Torsion - Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, **Sample Exercises**.		
UNIT – V	**AIRCRAFT STRUCTURAL REPAIR, AIRWORTHINESS AND AIRCRAFT CERTIFICATION**	**8**
Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements. Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices.		

TEXT BOOK:

1. Aircraft Design-A Conceptual Approach by Daniel P.Raymer, AIAA education series,6th Edition
2. Airframe Structural Design by Michael Niu, Conmilit Press, 1988,2nd Edition
3. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 1999,3rd Edition.

REFERENCES:

1. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
2. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006
3. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes & William A. Watkins, Glencoe &McGraw-Hill,6th Edition, 1993

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		Category	L	T	P	Credit
34121I21	**NEW PRODUCT DEVELOPMENT**	**EC-IE**	**3**	**0**	**0**	**3**

Preamble

To equip the students with the latest knowledge of Drawing study, Process Planning, cutting tool selection and fixture designing basics.

Prerequisite

NIL

Course Objectives

1	To understand the basic concepts of Drawing study.
2	To understand the operating parameters and the process sequence in process planning.
3	To understand the systems used in NPD.
4	To develop the skills for selection of Cutting tools and fixture design.
5	To understand the advanced computer Integrated Machining process.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Understands the Engineering Drawings and specification	Remember
CO2.	Estimation of process parameters and Planning.	Understand
CO3.	Applying the selection principles for fixtures	Apply
CO4.	Analyze different systems in New product development	Analyze
CO5.	Evaluate different methodologies in Design for Manufacturing	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	L	L	L	L	-	-	-	-	-	-	-	M	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	M	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	M	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	**DRAWING STUDY**	**9**

Types of views and projections -Limits and fits measurement techniques of surface finish-Geometrical dimensioning and tolerance-Measuring tools and instruments

UNIT – II	**PROCESS PLANNING**	**9**

Selection of a machine tool by considering type of machine and operating parameters- Deciding the process sequence based on the component

UNIT – III	**CUTTING TOOL SELECTION AND FIXTURE DESIGN**	**9**

Insert and tool holders for turning-Milling cutters and end mills-Clamping systems-Basic concepts and principles of fixture design-Designing a fixture based on component datum

UNIT – IV	**SYSTEMS IN NPD**	**9**

Systems used for lean manufacturing-Significance of CAM in costing

UNIT – V	**CURRENT TRENDS IN MANUFACTURING**	**9**

How to make first part right at fastest time-Green button concept-Factors missed out in cost estimation-Significance of integration of CAD/CAM in manufacturing

TEXT BOOK:

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
2. Product Design and Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGraw-HILL-3rd Editions, 2003.

REFERENCES:

1. Advances In Machining And Manufacturing Technology 2017 Edition by Singh R, Auris Publishing

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		Category	L	T	P	Credit
34121I24	QUALITY CONTROL-TOOLS AND PROBLEM SOLVING METHODOLOGIES	EC-IE	3	0	0	3

Preamble

To enlighten the students about the fundamentals of Design of experiment Techniques

Prerequisite

NIL

Course Objectives

1	To learn the basic concepts of Quality Management Tools.
2	To understand the usage of New Management Tools.
3	To understand the usage of SPC tools.
4	To understand the usage of Problem solving tools.
5	To understand the implementing Problem solving Methodology.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	To understand the selection of tools for Quality Management	Understand
CO2.	Understand the importance of New Management tools.	Understand
CO3.	To apply the SPC - Quality Control Tools	Apply
CO4.	Analyze various Problem solving tools accordingly	Analyze
CO5.	To evaluate different problem solving methodology	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS		
UNIT – I	**QUALITY MANAGEMENT TOOLS**	**9**

Evolution of Quality Management Concepts of Product and Service Quality Dimensions of Quality Deming's, Juran's, Crosby's Quality Philosophy Quality Cost.		
UNIT – II	**NEW MANAGEMENT TOOLS**	**9**

New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.		
UNIT – III	**SPC - QUALITY CONTROL TOOLS**	**9**
The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma,		
UNIT – IV	**PROBLEM SOLVING TOOLS**	**9**
Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs.		
UNIT – V	**PROBLEM SOLVING METHODOLOGY**	**9**
Fishbone diagrams, Fishbone diagrams, Strategy maps, Mental maps, Idea maps, Concept maps, Layered process audit software, Charting software.		

TEXT BOOK:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCES:

1. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
2. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

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OPEN ELECTIVE-INNOVATION, ENTREPRENEURSHIP, SKILL DEVELOPMENT COURSES

34121O01	ENGINEERING STARTUPS AND ENTREPRENEURIAL MANAGEMENT	Category	L	T	P	Credit
		OE-IE	3	0	0	3

PREAMBLE:

A startup means company initiated by individual innovator or entrepreneurs to search for a repeatable and scalable business model. More specifically, a startup is a newly emerged business venture that aims to develop a viable business model to meet a marketplace needs or wants in an optimum manner.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the basics of Startups Management and components.
2. To analyze the startups fund management practices
3. To practice the various kinds of stocks and employment considerations in startups.
4. To apply the importance of intellectual property rights and its procedures.
5. To explore the entrepreneurial mindset and culture.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Explain the concept of engineering startups, objectives and functions and its components.	Understand
CO2: Analyze the startups funding issues and remuneration practices in startups business.	Analyse
CO3: Analyze the various kinds of stocks and employment opportunities and consideration in startups business.	Analyse
CO4: Compare and contrast the various forms of intellectual property protection and practice.	Analyse
CO5: Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.	Evaluates

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	-	-	M	M	S	-	M	-	M	-	L	L
CO2	S	S	M	M	M	L	-	-	-	-	-	M	L	L	-
CO3	S	S	S	M	M	M	-	-	-	-	-	M	L	-	M
CO4	S	S	S	M	M	M	-	-	-	-	-	M	-	M	L
CO5	S	S	-	M	M	M	-	-	-	-	-	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS:

Elements of a successful Start up: Startup Process – Create Management Team and Board of Directors – Evaluate market and Target Customers – Define your product or service – preparation of business plan -

specific problems and challenge in startup.

Funding Issues and Remuneration Practices: Funding Issues: Investment Criteria – Looking for seed cash – Seed, Startup, and subsequent Funding Rounds – Milestone Funding - Remuneration Practices for your Start –up : Salaries – Equity Ownership – Other compensation – Employment Contracts

Stock Ownership & startup Employment Considerations: Stock ownership: Risk- Reward Scale – Ownership Interest over time – Common and preferred stock – Authorized and outstanding shares – Acquiring stock – Restricted Stock Grants – Future Tax Liability on Restricted Shares - Compensation and startup Employment Considerations : Entrepreneurs Need Insurance – Do Fringe benefits – outsourcing your benefits work – Life Insurance – Health Insurance – Disability Insurance

Protecting Intellectual Property: Protecting your intellectual property: Copyrights - patents–Trade secrets – Trademarks - The Legal Form of your Startup: Corporation – Partnership – Limited Liability Company – Sole Proprietorship - – Making the startup decision: commitment – Leaving a current employer - stay fit.

Startup Capital Requirements and Legal Environment:

Identifying Startup capital Resource requirements - estimating Startup cash requirements - Develop financial assumptions- Constructing a Process Map - Positioning the venture in the value chain - Launch strategy to reduce risks- Startup financing metrics - The Legal Environment- Approval for New Ventures- Taxes or duties payable for new ventures..

Text Book:

1. James A. Swanson & Michael L. Baird, "Engineering your start-up: A Guide for the High-Tech Entrepreneur" 2nd ed, Professional Publications.inc
2. Donald F Kuratko, " Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning 2014.

Reference Books:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
3. Rajeev Roy, „Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Dr. G. Murugesan	Professor	Management Studies	murugesan@vmkvec.edu.in
2	Mr. T. Thangaraja	Assistant Professor	Management Studies	thangaraja@avit.ac.in

34121O02	INTELLECTUAL PROPERTY RIGHTS	Category	L	T	P	Credit
		OE-IE	3	0	0	3

PREAMBLE: The course is designed to introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To introduce fundamental aspects of Intellectual property Rights
2. To disseminate knowledge on patents and copyrights
3. To disseminate knowledge on trademarks, Design and Geographical Indication (GI),
4. To disseminate knowledge on Plant Varieties, Layout Design Protection and create awareness about current trends in IPR
5. To disseminate knowledge on Legislation of IPRs and Alternate Dispute Resolution

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the important of intellectual property rights	Understand
CO2: Apply for the patents	Apply
CO3: Understand and apply for the copyrights	Understand
CO4: Understand the important of trademarks	Apply
CO5: Appreciate the importance of IPR and its related issues	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	-	L	S	L	-	L	-	L	L	M	-
CO2	L	S	S	M	M	L	-	-	-	-	-	L	M	L	-
CO3	L	S	L	M	M	L	-	-	-	-	-	L	M	L	-
CO4	L	S	S	S	M	L	-	-	-	-	-	L	L	L	-
CO5	L	S	S	M	-	L	-	-	-	-	-	L	M	L	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Unit 1 - Overview of Intellectual Property

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention,

1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994.

Unit 2 - Patents & Copyright

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

Copyright - Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and license of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

Unit 3 – Trademarks, Design and Geographical Indication (GI)

Trademarks: Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

Design: Meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection

Geographical Indication (GI): Meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection

Unit 4 - Plant Varieties, Layout Design and Indian National Intellectual Property Policy

Plant Variety Protection: Plant variety protection: meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection.

Layout Design Protection: Layout Design protection: meaning – Procedure for registration, effect of registration and term of protection.

Indian National Intellectual Property Policy: India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies

UNIT – V: Legislation of IPRs and Alternate Dispute Resolution

Legislation of IPRs: The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act - Patent Ownership and Transfer, Patent Infringement, International Patent Law

Alternate Dispute Resolution: Alternate Dispute Resolution and Arbitration – ADR Initiatives –Reason for Choosing ADR – Advantages and Disadvantages of ADR – Assessment of ADR's – Litigation – Arbitration - Effective Mechanism for Business Issues.

Text Books:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference Book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID
1	P. S. Balaganapathy	Associate Professor	Management	dydirectormanagementstudies@avit.ac.in
2	A. Mani	Associate Professor	Management	mani@vmkvec.edu.in

	INNOVATION, PRODUCT DEVELOPMENT AND	**Category**	**L**	**T**	**P**	**Credit**
34121O04	**COMMERCIALIZATION**	**OE-IE**	**3**	**0**	**0**	**3**

PREAMBLE

commercialization of innovation and new products in fast-paced, high-tech markets and matchingtechnological innovation to market opportunities.

PREREQUISITE - Not Required

COURSE OBJECTIVES

1	To make students understand multiple-perspective approach in organization to capture knowledge and creativity to develop successful products and services for Volatile, Uncertain, Complex and Ambiguous (VUCA) world.
2	Inculcate a disruptive thought process to generate ideas for concurrent and futuristic problems of society in general and markets in particular which focus on commercialization.
3	Improved understanding of organizational best practices to transform exciting technology into successful products and services.
4	Critically assess and evaluate innovation policies and practices in organizations especially from a cultural and leadership point of view.
5	Explain why innovation isessential to organizational strategy – especially in a global environment.

COURSE OUTCOMES

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

CO1: Understand the role of innovation in gaining and maintaining competitive advantage	Understand
CO2: Integrate the innovation basis and its role in decision making especially under uncertainty	Apply
CO3: Analyze business challenges involving innovation management	Apply
CO4: Having problem solving ability – solving social issues and business problems	Apply
CO5: Comprehend the different sources of innovation	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-
CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Pre-launch, during launch and Post launch preparations;

SYLLABUS:

Introduction to Innovation Management - Innovation – What it is? Why it Matters? - Innovation as a Core Business Process – system thinking for innovation – Framework for System Thinking - system thinking tools

Creating New Products and Services - Product and Service Innovation – Exploiting Open Innovation and Collaboration –The Concept of Design Thinking and Its Role within NPD and Innovation – framework for design thinking

Capturing Innovation Outcome - New Venture – Benefits of Innovation, and Learning from Innovation – Building Innovative Organization and Developing Innovation Strategy - Globalization for Innovations, Innovating for Emerging Economies and Role of National Governments in Innovation

New Product Brand Development and Pricing Strategies - Importance of Brand decisions and Brand identity development; Pricing of a new product, Pre-test Marketing

The Product offer Selecting Market opportunity and Designing new market offers-Concept Generation and Evaluation, Developing and Testing Physical offers - Pre-launch, during launch and Post launch preparations;

Text Book:

1. Joe Tidd, John Bessant (2013), Managing Innovation: Integrating Technological, Market and Organizational Change, 5th edition, Wiley.

Reference Books:

1. Schilling, M (2013), Strategic management of technological innovation, 4th edition, McGraw Hill Irwin.
2. Allan Afuah (2003), Innovation Management: Strategies, Implementation and Profits, 2nd edition, Oxford University Press.
3. Michael G. Luchs, Scott Swan, Abbie Griffin (2015), Design Thinking: New Product Development Essentials from the PDMA, Wiley-Blackwell.
4. John Boardman, Brian Sauser (2013), Systemic Thinking: Building Maps for Worlds of Systems, 1st edition, Wiley.
5. Rich Jolly (2015), Systems Thinking for Business: Capitalize on Structures Hidden in Plain Sight, Systems Solutions Press

COURSE DESIGNERS:

S.No	Name of the faculty	Designation	Department	E-Mail Id
1			Management Studies	
2			Management Studies	

		Category	L	T	P	Credit
34121O07	**SOCIAL ENTREPRENEURSHIP**	**OE-IE**	**3**	**0**	**0**	**3**

PREAMBLE

Social entrepreneurship involves the creativity, imagination and innovation often associated with entrepreneurship.

PREREQUISITE –

Not Required

COURSE OBJECTIVES

1	To provide students with a working knowledge of the concepts, opportunities and challenges of social entrepreneurship.
2	To demonstrate the role of social entrepreneurship in creating innovative responses to critical social needs (e.g., hunger, poverty, inner city education, global warming, etc).
3	To engage in a collaborative learning process to develop a better understanding of the context and domain of social entrepreneurship.
4	To help prepare you personally and professionally for meaningful employment by reflecting on the issues of social entrepreneurship.
5	Engage with a diverse group of social entrepreneurs.

COURSE OUTCOMES

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

CO1: Explain the concept social entrepreneurship and distinguish its elements from across a continuum of organizational structures from traditional nonprofits to social enterprises to traditional for profits	Understand
CO2: Analyze the operations of a human service organization using social entrepreneurial orientation and industry assessment and diagnostic tools.	Apply
CO3: Apply the Social Business Model Canvas and lean startup methods for planning, developing, testing, launching and evaluating social change ventures.	Apply
CO4: Compare funding options for social change ventures.	Apply
CO5: The outcomes of social entrepreneurship are focused on addressing persistent social problems particularly to those who are marginalized or poor.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**P012**
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-
CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Social entrepreneurship – dimensions of social entrepreneurship – social change theories – equilibrium and

complexity – theory of social emergence

Social entrepreneurs – mindset, characteristics and competencies – developing a social venture sustainability model – feasibility study – planning – marketing challenges for social ventures

Microfinance– MFI (Micro Finance Institutions) in India – regulatory framework of MFI – Banks and MFIs – sustainability of MFI – Self Help Groups– successful MFI models

Angel Investors & Venture Capitalists – difference – valuation of firm – negotiating the funding agreement – pitching idea to the investor

Corporate entrepreneurship – behavioral aspects – identifying, evaluating and selecting the opportunity – venture– location – organization – control – developing business plan – funding the venture – implementing corporate venturing in organization.

Text Book:

1. Constant Beugré, Social Entrepreneurship: Managing the Creation of Social Value, Routledge, 2016.

2. Björn Bjerke, Mathias Karlsson, Social Entrepreneurship: To Act as If and Make a Difference, Edward Elgar Publishing, 2013.

Reference Books:

1. Wei-Skillern, J., Austin, J., Leonard, H., & Stevenson, H. (2007). Entrepreneurship in the Social Sector (ESS). Sage Publications.
2. Janus, K. K. (2017). Social startup success. New York, NY: Lifelong Books.
3. Dancin, T. M., Dancin, P. A., & Tracey, P. (2011). Social entrepreneurship: A critique and future directions.
4. Alex Nicholls, Social Entrepreneurship: New Models of Sustainable Social Change, OUP Oxford, 2008.
5. David Bornstein, Susan Davis, Social Entrepreneurship: What Everyone Needs to Know, Oxford University Press, 2010.

COURSE DESIGNERS:

S.No	Name of the faculty	Designation	Department	E-Mail Id
1			Management Studies	
2			Management Studies	

		Category	L	T	P	Credit
34121O06	**NEW VENTURE PLANNING AND MANAGEMENT**	**OE-IE**	**3**	**0**	**0**	**3**

PREAMBLE

Contemporary methods and best practices for the entrepreneur to plan, launch, and operate a newventure and creation of a business plan

PREREQUISITE - Not Required

COURSE OBJECTIVES

1	An opportunity for self-analysis, and how this relates to success in an entrepreneurial environment.
2	Information and understanding necessary to launch and grow an entrepreneurial venture.
3	A realistic preview of owning and operating an entrepreneurial venture.
4	An entrepreneur must understand the diversity, emotional involvement, and workload necessary to succeed.
5	The opportunity to develop a business plan.

COURSE OUTCOMES

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

CO1: Explain the concept of new venture planning, objectives and functions and its components.	Understand
CO2: Analyze the business plan issues and remuneration practices in startups business.	Apply
CO3: Explore an entrepreneurial idea to the point where you can intelligently and decide whether to "go for it" or not.	Apply
CO4: Compare and contrast the different forms entrepreneurial environment in terms of their key differences and similarities.	Apply
CO5: Explore the business plan and business model canvas for your idea.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**P012**
CO1	M	-	-	-	-	M	S	S	-	M	-	-
CO2	S	S	S	M	M	M	-	-	-	-	-	-
CO3	S	S	S	M	M	M	-	-	-	-	-	-
CO4	S	S	S	M	M	M	-	-	-	-	-	-
CO5	S	S	S	M	M	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

STARTING NEW VENTURE: Opportunity identification - Search for new ideas - Sources of innovative ideas - Techniques for generating ideas - Entrepreneurial imagination &creativity - The role of creative thinking - Developing your creativity - Impediments to creativity.

METHODS TO INITIATE VENTURES: Pathways to new venture - Creating new ventures - Acquiring an existing venture - Advantages of acquiring an established venture - Examination of key issues – Franchising -

How a franchise works and franchise law - Evaluating franchising opportunity.

THE SEARCH FOR ENTREPRENEURIAL CAPITAL: The venture capital market - Criteria for evaluating new venture proposals - Evaluating venture capitalists - stage of venture capital financing - Alternate sources of financing for Indian entrepreneurs - Bank funding - State financial corporations - Business incubators and facilitators - Informal risk capital - Angel investors.

THE MARKETING ASPECTS OF NEW VENTURE: Developing a marketing plan - Customer analysis - Sales analysis - Competition analysis - Market research - Sales forecasting - Sales Evaluation - Pricing decisions.

BUSINESS PLAN PREPARATION FOR NEW VENTURE: Business plan concept - Pitfalls to avoid in business plan - Developing a well conceived business plan - Elements of a business plan - Harvest strategy - Form of business organization - Legal acts governing businesses in India.

Text Book:

1. The Successful Business Plan, Secrets & Strategies, Rhonda Abrams, Published by The Planning Shop Titan, Ron Chernow, Random House
2. Osterwalder, A. and Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Hoboken, NJ: John Wiley & Sons

Reference Books:

1. Blackwell, E. (2011). How to Prepare a Business Plan: Create Your Strategy; Forecast Your Finances; Produce That Persuasive Plan. Kogan Page Publishers.
2. Levi, D. (2014). Group Dynamics for Teams. Sage Publications, Inc. Thousand Oaks.
3. Rajeev Roy, „Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. Business Model Generation by Osterwalder and Pigneur.

COURSE DESIGNERS:

S.No	Name of the faculty	Designation	Department	E-Mail Id
1			Management Studies	
2			Management Studies	

	FINANCE AND ACCOUNTING	Category	L	T	P	Credit
34121O03	FOR ENGINEERS	OE-IE	3	0	0	3

PREAMBLE:

Engineers are in a position to do Decision Making during every activity in the industry. The activities ranging from Operation to Non-Operation during the routine functions of the organization. Especially, Finance and Accounting also becomes the part of responsibility of every engineer to do data analysis activities. His interpretation through data analysis and reporting in every transaction helps the organization to do decision making to run the organization effectively and efficiently. Finance and Accounting Practices enable the engineers to handle the resources to do cost and Financial decisions with optimum resources for the betterment of the organization.

PREREQUISITE: Not Required

COURSE OBJECTIVES:

1. To understand the concepts and conventions to prepare Income Statement, and Balance Sheet.
2. To apply the various methods to claim depreciation.
3. To practice fundamental investment decision through capital budgeting techniques.
4. To analyse cost-volume profit analysis for decision making and analyse standard costing techniques.
5. To estimate the working capital requirements for day-to-day activities and handling inventories with economic ordering quantities.

COURSE OUTCOMES:

After successful completion of the course, students will be able to

CO1: Understand the importance of recording, book keeping and reporting of the business transaction.	Understand
CO2: Identify and Apply suitable method for charging depreciation on fixed assets.	Apply
CO3: Analyse the various methods of capital budgeting techniques for investment decision.	Apply
CO4: Justify the scope of cost-volume-profit analysis, standard costing, and marginal costing techniques for decision making.	Analyse
CO5: Estimation of working capital requirements of the organization.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	M	L	S	M	-	S	-	M	M	L	M	L	M
CO2	L	-	-	L	M	-	L	L	-	-	L	M	L	L	-
CO3	-	M	-	M	L	-	-	L	S	M	-	L	-	L	M
CO4	L	L	-	S	-	-	L	-	-	L	M	L	M	L	M
CO5	L	-	L	S	L	-	-	M	M	L	-	L	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Introduction: Business Environment – Book Keeping and Accounting – Accounting Concepts and Conventions – Double entry system – Preparation of journal, ledger and Trial balance – Final Accounts.

Deprecation: Meaning – Causes - Methods of Calculating Depreciation: Straight Line Method, Diminishing Balance Method and Annuity Method.

Capital Budgeting Decisions: Meaning – Nature & Importance of Investment Decisions – Types - Financial statement analysis and interpretation - Types of Analysis - Objectives - Tools of Analysis - Ratio Analysis: Objectives, Uses and Limitations - Classification of Ratios: Liquidity, Profitability, Financial and Turnover Ratios - Funds Flow Analysis and Cash Flow Analysis: Sources and Uses of Funds, Preparation of Funds Flow statement, Uses and Limitations: Pay Back Period – Accounting Rate of Return – NPV – IRR - Profitability Index.

Marginal Costing: Marginal Cost - Breakeven Analysis - Cost Volume Profit Relationship - Applications of Standard and marginal Costing Techniques.

Working Capital Management: – Types of Working Capital – Operating Cycle – Determinants of Working Capital - Receivables Management – Inventory Management – Need for holding inventories – Objectives – Inventory Management Techniques: EOQ & Reorder point – ABC Analysis - Cash Management – Motives for holding cash.

Text Book

1. Kesavan, C. Elenchezhian, and T. Sunder Selwyan, "Engineering Economics and Financial Accounting", Firewall Media, 2005.
2. Kasi Reddy .M and Saraswathi.S, "Managerial Economics and Financial Accounting", PHI Learning Pvt., Ltd. 2007.

Reference Book

1. Periyasamy .P, "A Textbook of Financial, Cost and Management Accounting", Himalaya Publishing House, 2010.
2. Palanivelu V.R., "Accounting for Managers", Lakshmi Publications, 2005.
1. Mark S Bettner, Susan Haka, Jan Williams, Joseph V Carcello, "Financial and Management Accounting", Mc-Graw-Hill Education, 2017

COURSE DESIGNERS:

S.No	Name of the Faculty	Designation	Department	Mail ID
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OPEN ELECTIVE – EMERGING AREA COURSES

		Category	L	T	P	Credit
35321O01	**BIOSENSORS AND TRANSDUCERS**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

The course is designed to make the student acquire conceptual knowledge of the transducers and biological components used for the detection of an analyte. The relation between sensor concepts and biological concepts is highlighted. The principles of biosensors that are currently deployed in the clinical side are introduced.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To use the basic concepts of transducers, electrodes and its classification.
2	To discuss the various types of electrodes.
3	To determine the recording of biological components.
4	To employ the knowledge in electrochemical and optical biosensors.
5	To outline the various biological components using biosensors.

COURSE OUTCOMES

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

CO1. Describe the working principles of transducers.	Understand
CO2. Explain the various types of electrodes.	Understand
CO3. Utilize various FET sensors for recording of biological components.	Apply
CO4. Distinguish various biosensors like electrochemical and optical biosensors.	Analyze
CO5. Analyze the biological components using biosensors in various applications.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO2	M	L	--	M	--	M	--	--	L	--	--	M	--	M	--
CO3	S	M	L	S	--	S	M	M	M	--	--	M	M	M	M
CO4	S	S	L	S	--	S	M	M	S	--	--	M	M	M	S
CO5	S	S	L	S	--	S	M	M	S	--	--	S	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: General measurement system, Transducers and its classification, Resistance transducers, capacitive transducer, Inductive transducer.

TRANSDUCERS:

Temperature transducers, piezoelectric transducers, Piezo resistive transducers, photoelectric transducers.

BIO POTENTIAL ELECTRODES:
Half cell potential, Types of Electrodes –Micro electrodes, Depth and needle electrodes, Surface electrodes, Chemical electrodes, Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

BIOSENSORS:
Biological elements, Immobilization of biological components, Chemical Biosensor-ISFET, IMFET, electrochemical sensor, chemical fibro sensors.

APPLICATIONS OF BIOSENSORS:
Bananatrode, blood glucose sensors, non invasive blood gas monitoring, UREASE biosensor, Fermentation process control, Environmental monitoring, Medical applications.

TEXT BOOKS:

1. H.S. Kalsi, **"Electronic Instrumentation & Measurement"**, Tata McGraw HILL, 1995.
2. Brain R Eggins, **"Biosensors: An Introduction",** John Wiley Publication, 1997.
3. Shakthi chatterjee, **"Biomedical Instrumentation"**, Cengage Learning, 2013.
4. John G Webster, **"Medical Instrumentation: Application and design"**, John Wiley Publications, 2001.

REFERENCES:

1. K.Sawhney, **"A course in Electronic Measurements and Instruments"**, Dhanpat Rai & sons, 1991.
2. John P Bentley, **"Principles of Measurement Systems"**, 3rd Edition, Pearson Education Asia, (2000 Indian reprint).
3. Geddes and Baker, **"Principles of Applied Biomedical Instrumentation"**, 3rd Edition, John Wiley Publications, 2008.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.L.K.Hema	Professor & Head	BME	hemalk@avit.ac.in
2	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
3	Mr.V.Prabhakaran	Assistant Professor (Gr-II)	BME	Prabhakaran.bme@avit.ac.in
4	Mrs.S.Vaishnodevi	Assistant Professor	BME	vaishnodevi@vmkvec.edu.in

		Category	L	T	P	Credit
35321O03	PRINCIPLES OF BIOMEDICAL INSTRUMENTATION	OE-EA	3	0	0	3

PREAMBLE

To able the students to develop knowledge of principles, design and applications of the Biomedical Instruments.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To know about bioelectric signals, electrodes and its types.
2	To know the various Biopotential recording methods.
3	To study about patient monitoring concept and various Physiological measurements methods.
4	To study the principle of operation blood flow meter, blood cells counter.
5	To study about bio chemical measurements and details the concept of biotelemetry and patient safety.

COURSE OUTCOMES

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

CO1. Explain the different Bio signal or biopotential.	Understand
CO2. Discuss the working principles of diagnostic and therapeutic equipments.	Understand
CO3. Examine the various instruments like as ECG, EMG, EEG, X-ray machine.	Apply
CO4. Illustrate medical instruments based on principles and application used in hospital.	Analyze
CO5. Analyze and calibrate fundamental biomedical instrumentation used in hospital.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	--	--	-	--	--	--	--	--	--	--	L	M	--	--
CO2	M	--	--	--	--	--	--	--	L	--	--	L	M	--	--
CO3	S	S	M	S	M	--	--	--	M	--	--	M	M	M	S
CO4	S	M	M	M	L	--	--	L	S	L	--	S	M	S	S
CO5	S	S	M	M	L	M	--	L	S	L	--	S	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BIOELECTRIC SIGNALS AND ELECTRODES

Basic medical instrumentation system, Origin of Bioelectric Potential, Recording electrodes – Electrode Tissue interface, Electrolyte – skin interface, Polarization, Skin contact impedance, motion artifacts. Electrodes – Silver – silver chloride electrodes, electrodes for ECG, electrodes for EEG, electrodes for EMG, Electrical conductivity of electrode jellies and creams, Microelectrodes.

BIO AMPLIFIER AND BIOMEDICAL RECORDERS

Bioamplifier, Need for Bioamplifier, Differential amplifier, Instrumentation amplifier, Chopper amplifier, Isolation Amplifier, ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods, typical waveform.

PATIENT MONITORING SYSTEM AND NON ELECTRICAL PARAMETERS MEASUREMENTS

System concepts of patient monitoring system, Bedside patient monitoring system, central monitors, Blood pressure measurement, Measurement of temperature, Respiration rate measurement, cardiac output measurement, Measurement of pulse rate, Plethysmography technique.

BLOOD FLOW METERS, BLOOD CELL COUNTERS

Electromagnetic blood flow meter, ultrasonic blood flow meter, Laser Doppler blood flow meter, Types of blood cells, Methods of cell counting, coulter counters, automatic recognition and differential counting.

BIO- CHEMICAL MEASUREMENTS AND BIOTELEMETRY AND PATIENT SAFETY

Ph, Pc02, p02, Phco3 and electrophoresis, colorimeter, spectrophotometer, flame photometer, auto-analyser. Biotelemetry-wireless telemetry, single channel telemetry, multichannel telemetry, multi patient telemetry.

TEXT BOOKS:

1. Khandpur R.S, **"Hand-book of Biomedical Instrumentation"**, Tata McGraw Hill, 2nd Edition, 2003.
2. Leslie Cromwell, Fred Weibell J, Erich Pfeiffer. A, **"Biomedical Instrumentation and Measurements"**, Prentice-Hall India, 2nd Edition, 1997.

REFERENCES:

1. John G. Webster, **"Medical Instrumentation application and design"**, John Wiley, 3rd Edition, 1997.
2. Carr, Joseph J, Brown, John.M, **"Introduction to Biomedical equipment technology"**, John Wiley and sons, New York, 4th Edition, 1997.

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
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4	Ms. Lakshmi Shree	Assistant Professor	BME	lakshmishree.bme@avit.ac.in

		Category	L	T	P	Credit
38121O02	INTRODUCTION TO BIOFUELS	OE-EA	3	0	0	3

PREAMBLE

This course will provide an overview of existing energy utilization, production and infrastructure. We will also cover the consequences of our energy choices on the environment. The topics covered will include the chemistry of biofuels, the biology of important feedstocks, the biochemical, genetic and molecular approaches being developed to advance the next generation of biofuels and the economical and global impacts of biofuel production.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand the different types and differences between existing energy resources.
2	To understand the improcurement, utilization and their impacts on society and environment
3	To gain knowledge about the existing different biofuels and the methods of production from different sources
4	To introduce the techonologies involved in the production, characterization of biofuels
5	To impacrt the knowledge and applications of biofuel in various sectors and their beneficial aspects to the society.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understand the existing and emerging biomass to energy technologies	Remember
CO2. Understand the concept of 1st generation, 2nd generation and advance biofuels	Understand
CO3. Appraise the techno-economic analyses of biofuel conversion technologies	Understand
CO4. To articulate the concept of a biorefinery system and be able to develop major unit operations of an integrated biorefinery	Apply
CO5. Illustrate the environmental implications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	L	-	M	-	S	L	-	-	-	-	S	-	L
CO2	-	S	S	-	M	-	L	-	-	-	-	-	-	S	L
CO3	S	M	-	M	-	M	-	L	L	-	-	-	S	-	L
CO4	-	S	M	-	M	L	L	-	-	-	-	-	-	S	M
CO5	-	-	-	-	-	-	-	S	M	-	-	-	-	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF BIOFUELS

Generation of biofuels − Development of biological conversion technologies − Integration of biofuels into biorefineries − Energy security and supply − Environmental sustainability of biofuels − Economic sustainability of biofuels.

BIODIESEL

Biodiesel − Microorganisms and raw materials used for microbial Oil production − Treatment of the feedstocks prior to production of the Biodiesel − Current technologies of biodiesel production − Purification of biodiesel; Industrial production of biodiesel − Biodiesel production from single cell oil.

BIOETHANOL

Bioethanol – Properties – Feedstocks − Process technology − Pilot plant for ethanol production from lignocellulosic feedstock − Environmental aspects of ethanol as a biofuel.

BIOMETHANE AND BIOHYDROGEN

Biomethanol − Principles, materials and feedstocks − Process technologies and techniques − Advantages and limitations − Biological hydrogen production methods − Fermentative hydrogen production − Hydrogen economy − Advantages and limitations.

OTHER BIOFUELS

Biobutanol production − Principles, materials and feedstocks − Process technologies – Biopropanol – Bioglycerol − Production of bio-oils via catalytic pyrolysis − Life-Cycle environmental impacts of biofuels and Co-products.

TEXT BOOKS:

1. Luque, R., Campelo, J.and Clark, J. Handbook of biofuels production, Woodhead Publishing Limited 2011 2. Gupta, V, K. and Tuohy, M, G. Biofuel Technologies, Springer, 2013 3. Moheimani, N. R., Boer, M, P, M, K, Parisa A. and Bahri, Biofuel and Biorefinery Technologies, Volume 2, Springer, 2015

REFERENCES:

1.Eckert, C, A. and Trinh, C, T. Biotechnology for Biofuel Production and Optimization, Elsevier, 2016 2. Bernardes, M, A, D, S. Biofuel production – recent developments and prospects, InTech,2011

COURSE DESIGNERS

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1	Dr.A.Balachandar	Assistant Professor – Gr-II	Biotechnology	balachandar.biotech@avit.ac.in
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		Category	L	T	P	Credit
38121O01	FOOD AND NUTRITION TECHNOLOGY	OE-EA	3	0	0	3

PREAMBLE

The course aims to enable the students to understand the physicochemical, nutritional, microbiological and sensory aspects, To familiarize the students about the processing and preservation techniques. To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Understand the tradition food processing techniques and the basics concept of food biochemistry
2	Demonstrate the product development technique, quality and contaminant check
3	To articulate their technical knowledge for industrial purpose
4	Describe national food laws and standards
5	Laws and qualities of standard for food products

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1: Recall the processing techniques practiced in olden days and the biological process	Remember
CO2. Illustrate the methods for animal product development, quality control and also screen the contaminant	Understand
CO3.Transfer the techniques in scaling up for industrial needs	Apply
CO4. Interpret and Troubleshoot instruments to maintain accuracy	Apply
CO5. Develop standards for food additives	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	M	S	M	L	-	-	-	-	-	-	-	M	L	-
CO4	M	S	S	M	L	-	-	-	-	-	-	-	S	S	-
CO5	-	S	S	M	M	-	-	-	-	-	-	M	L	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO FOOD BIOTECHNOLOGY

Introduction, History and scope of food Biotechnology, development and prospects of biotechnology in animal products, ancient and traditional food processing techniques; Biochemical and metabolic pathways of biological systems used in food production.

METHODS IN FOOD BIOTECHNOLOGY: Role of biotechnology in productivity of livestock, Modern biotechnological methods and processes in animal product development, chemical and physical factors required for growing microbial cultures in nutritive substrate; Meat species identification, Quality control, Screening products for contaminants

BIOTECHNOLOGY METHODS IN FOOD PROCESSING:

Use of biotechnology in the production of food additives, use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, Basic principles of the industrial use of bio-reactions for production of biomass-upstream and downstream processing application of microorganisms as starter cultures in meat industry, microbial production of food ingredients; Biosensors and novel tools and their application in food science.

HURDLE TECHNOLOGY:

Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology

FOOD SAFETY & SECURITY:

Consumer concerns about risks and values, biotechnology & food safety, Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; Future and applications of food biotechnology in India.

TEXT BOOKS:

1. Potter, Norman. M. Food Science, 5th Ed. Springer US

2. Manay, S.; Shadakshara Swamy, M., (2004). Foods: Facts and Principles, 4 th Ed. New Age Publishers.

3. B. Srilakshmi., (2002) Food Science, New Age Publishers.

REFERENCES:

1. Meyer, (2004). Food Chemistry. New Age

2. Deman JM. (1990) Principles of Food Chemistry. 2 nd Ed. Van Nostrand Reinhold, NY

3. Ramaswamy H and Marcott M. Food Processing Principles and Applications. CRC Press

COURSE DESIGNERS

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		Category	L	T	P	Credit
34221O01	**DISASTER RISK MANAGEMENT**	**OE-EA**	**3**	**0**	**0**	**3**

Preamble

This course deals with the various disasters and to expose the students about the measures, its effect against built structures, and Hazard Assessment procedure in India. This course also deals with the methods of mitigating various hazards such that their impact on communities is reduced.

Prerequisite

NIL

Course Outcomes

1	To Understand basic concepts in Disaster Management
2	To Understand Definitions and Terminologies used in Disaster Management
3	To Understand the Challenges posed by Disasters
4	To understand Impacts of Disasters

COURSE OUTCOMES

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

CO1. Understand the various types of disaster viz Hydrological, Coastal and Marine Disasters, Atmospheric Disasters, Geological, Mass Movement and Land Disasters, Wind and Water Driven Disasters.	Understand
CO2. Identify the potential deficiencies of existing buildings for Earthquake disaster and suggest suitable remedial measures.	Understand
CO3.Derive the guide lines for the precautionary measures and rehabilitation measures for Earthquake disaster.	Apply
CO4. Derive the protection measures against floods, cyclone, land slides	Apply
CO5. Understand the effects of disasters on built structures in India	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION: Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events (Global, national and regional); Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etcDos and Don'ts during various types of Disasters.

RISK ASSESSMENT AND VULNERABILITY ANALYSIS: Response time, frequency and forewarning levels of different hazards; Characteristics and damage potential of natural hazards; hazard assessment ;Dimensions of vulnerability factors; vulnerability assessment; Vulnerability and disaster risk; Vulnerabilities to flood and earthquake hazards

DISASTER MANAGEMENT MECHANISM: Concepts of risk management and crisis management ; Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness; Planning for relief, Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster

DISASTER RESPONSE: Mass media and disaster management; Disaster Response Plan; Communication, Participation, and Activation of Emergency Preparedness Plan; Logistics Management; Psychological Response; Trauma and Stress Management; Rumour and Panic Management; Minimum Standards of Relief; Managing Relief; Funding.

DISASTER MANAGEMENT IN INDIA: Strategies for disaster management planning; Steps for formulating a disaster risk reduction plan; Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake- holders

TEXT BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
2. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
3. Goswami, S. C. Remote Sensing Application in North East India, Purbanchal Prakesh, Guwahati, 1997.
4. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.
5. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. National Policy on Disaster Management, NDMA, New Delhi, 2009.
7. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi, 2005.

Course Designers

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Ms.S.Ispara Xavier	Assistant Professor	Civil / AVIT	isparaxavier.civil@avit.ac.in

		Category	L	T	P	Credit
34221O02	**MUNICIPAL SOLID WASTE MANAGEMENT**	**OE-EA**	**3**	**0**	**0**	**3**

Preamble

Structure is an arrangement and organization of interrelated elements in a material object or system, or the object or system so organized. Material structures include man-made objects such as buildings and machines and natural objects such as biological organisms, minerals and chemicals.

Prerequisite

Nil

Course Objectives

1.	The on-site/off-site processing of the same and the disposal methods.
2.	The student is expected to know about the various effects and disposal options for the municipal solid waste.
3.	The collection and supply of water
4.	The offsite processing involved in site

Course Outcomes

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

CO1. To know about the types of waste & Sources	Analyze
CO2 . To Study the on site Storage & Processing	Apply
CO3. To study about the collection & transfer the waste	Apply
CO4. To Study the process of off site processing	Apply
CO5. To know about the solid waste disposal	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**L**	-	-	-	-	-	-	-	-	-		-	**S**
CO2	**S**	**M**	**L**	**S**	-	-	-	-	-	-	-	-		**M**	**S**
CO3	**S**	**M**	**M**	**S**	-	-	-	-	-	-	-	-		**M**	**S**
CO4	**S**	**M**	**M**	**M**	-	-	-	-	-	-	-	-		**M**	**S**
CO5	**S**	**M**	**M**	-	-	-	-	-	-	-	-	**L**		-	**S**

S- Strong; M-Medium; L-Low

Syllabus

SOURCES AND TYPES OF MUNICIPAL SOLID WASTES

Sources and types of solid wastes-major legislation-monitoring responsibilities-Effects of disposal of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization– public health effects. Principle of solid waste management – social & economic aspects; Public awareness; Role of NGOs; Legislation.

ON-SITE STORAGE & PROCESSING

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

COLLECTION AND TRANSFER

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, Anaerobic digestion, RDF and Incineration and co-generation of energy using waste, Pyrolysis of solid Waste operation & maintenance; options under Indian conditions.

OFF-SITE PROCESSING

Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions- cradle to grave management concept, Prevailing laws of hazardous waste management- Risk assessment.

DISPOSAL

Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Text Books

1. George Tchobanoglous et.al., “Integrated Solid Waste Management”, McGraw-HillPublishers, 2002.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, “Waste Management”,Springer, 1994.
3. Charles A. Wentz; "Hazardous Waste Management", McGraw-Hill Publication, Latest

publication, (1992).

Reference Books

1. R.E.Landreth and P.A.Rebers, “Municipal Solid Wastes – problems and Solutions”, Lewis

   Publishers, 1997, Bhide A.D. and Sundaresan, B.B., “Solid Waste Management in Developing Countries”,

   INSDOC, 1993.
2. Handbook of Solid Waste Management by Frank Kreith, George Tchobanoglous, McGraw Hill Publication, (2002), Bagchi, A., Design, Construction, and Monitoring of Landfills, (2nd Ed). Wiley Interscience, ISBN: 0-471-30681-9, Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development.
3. Government of India, New Delhi, (2000).
4. NPTEL – Municipal Soild Waste Management by Prof. Ajay Kalamdhad – IIT Guwahati.

Course Designers

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.P.Subathra	Assistant Professor	Civil / AVIT	subathra@avit.ac.in
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		Category	L	T	P	Credit
35021O02	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

This syllabus is intended for the Engineering students and enable them to lean about Artificial Intelligence. This syllabus contains intelligent agent, Knowledge Representation and Game playing. Thus, this syllabus focuses on to know about AI and its concepts.

PREREQUISITE :NIL

COURSE OBJECTIVES

1.	To introduce the basic principles, techniques, and applications of Artificial Intelligence.
2.	To have knowledge of generic problem-solving methods in Artificial Intelligence.
3.	To design software agents to solve a problem.
4.	Apply the knowledge of algorithms to solve arithmetic problems.
5.	Assemble an efficient code for engineering problems.

COURSE OUTCOMES

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

CO1:. Identify the different agent and its types to solve the problems	Understand
CO2: know about the problem solving technique in Artificial Intelligence.	Apply
CO3: Construct the normal form and represent the knowledge.	Apply
CO4: to know about extension of condition probability and how to apply in the real time environment.	Apply
CO5: To lean about Information Retrieval and Speech Recognition	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	PSO2	PSO3
CO1	M	M	M	M	M	-	-	-	-	-	-	M	S	M	-
CO2	M	M	L	M	L	-	-	-	-	-	M	M	S	M	M
CO3	M		S	M	M	-	-	-	-	-	-	M	S	-	M
CO4	S	M	M	M	M	-	-	-	-	-	-	M	S	M	M
CO5	S	M	M	M	M	-	-	-	-	-	-	M	S	M	-

S- Strong; M-Medium; L-Low

INTRODUCTION

What is AI? – AI Problems – What is an AI technique – Defining the problem as a state space search – Production system - Production system – Characteristics – Problem Characteristics?

HEURISTIC SEARCH TECHNIQUES

Generate and test – Hill Climbing – Best first Search – Problem Reduction – Constraints satisfaction – Means end analysis.

KNOWLEDGE REPRESENTATION

Propositional Logic-First Order Predicate Logic-Prolog Programming-Unification-Forward Chaining- Backward Chaining-Ontological Engineering-Categories and Objects-Events-Mental Events and Mental Objects.

REPRESENTING KNOWLEDGE USING RULES

Procedural versus – Declarative Knowledge – logic Programming – Forward versus Backward Reasoning – Matching

GAME PLAYING

The Minimax search procedure – Adding Alpha Beta cut offs – Addition Refinements – Waiting for Quiescence – Secondary Searches – Using Book moves.

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education, 2015
Bratko, I., Prolog Programming For Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th Edition, 2011..

REFERENCES

1. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: A Logical Approach", Oxford University Press, 2004.
2. G. Luger, "Artificial Intelligence: Structures and Strategies For Complex Problem Solving", Fourth Edition, Pearson Education, 2002.
3. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publishers, 1998.

COURSE DESIGNERS

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1	Dr.M.Nitya	Professor	CSE	nithya@vmkvec.edu.in
2	Dr.R.Jaichandran	Professor	CSE	rjaichandran@avit.ac.in

		Category	L	T	P	Credit
35021O03	**INTRODUCTION TO INTERNET OF THINGS**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

Introduction to IoT for statistical data manipulation and analysis. It was inspired by and is most compatible with the statistical language.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To learn Introduction to IoT.
2	To Study methodology of IoT.
3	To Develop IoT applications using Arduino and Intel Edition.

COURSE OUTCOMES

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

CO1: To Understand the basics in Introduction to IoT in terms of constructs, control statements, string functions	Understand
CO2: To Understand the use of Introduction to IoT fundamentals.	Understand & Apply
CO3: Learn to apply Introduction to IoT for Communicating Sequential Process	Understand & Apply
CO4: Able to appreciate and apply the Introduction to IoT from a statistical perspective	Understand & Apply
CO5 To learn Introduction to IoT Challenges	Understand & Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	M	M	L	S	S	M	S	L	S	-	**S**	M	S
CO2												M	M	M	S
CO3	M	S	M	M	M	S	S	M	S	M	M	-	M	-	S
CO4												M	M	S	M
CO5	S	S	S	S	M	S	S	S	S	M	S	S	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I –INTRODUCTION to IoT

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

.

UNIT II- IoT & M2M

Machine to Machine, Difference between IoT and M2M, Software define Network

UNIT III – Network & Communication aspects

Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

UNIT IV – Domain specific applications of IoT

Design challenges, Development challenges, Security challenges, Other challenges

UNIT V – Reflection, Low-Level Programming

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

TEXT BOOKS

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

REFERENCES

1. Macro Schewartz, “Internet of Things with the Arduino Yun” Packet Publishing, 2014.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Jaichandran	Professor	CSE	rjaichandran@avit.ac.in
2	Dr.M.Nitya	Professor	CSE	nithya@vmkvec.edu.in

		Category	L	T	P	Credit
35021O01	**CYBER SECURITY**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

To understand the need for Cyber Security in real time and to study techniques involved in it.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the fundamentals of Cyber Security and issues
2.	To study various cyber crimes and legal remedies
3.	To apply various privacy and security
4.	To study E-Commerce and digital payments
5.	To study the basic security aspects related to Computer and Mobiles

COURSE OUTCOMES

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

CO1: Able to understand the concept of Cyber security and issues and challenges associated with it.	Understand
CO2: Able to understand the cyber crimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures	Apply
CO3: Able to appreciate various privacy and security concerns on online Social media and understand the reporting procedure of inappropriate content, underlying legal aspects and best practices for the use of Social media platforms.	Apply
CO4: Able to understand the basic concepts related to E-Commerce and digital payments.	Apply
CO5: Able to understand the basic security aspects related to Computer and Mobiles.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M		-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	S	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO CYBER SECURITY	**9 hours**
Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.	
CYBER CRIME AND CYBER LAW	**9 hours**
Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies.	
SOCIAL MEDIA OVERVIEW AND SECURITY	**9 hours**
Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.	
E - C O M M E R C E AND DIGITAL PAYMENTS	**9 hours**
Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payament Settlement Act,2007.	
DIGITAL DEVICES S E C U R I T Y , TOOLS AND TECHNOLOGIES FOR CYBER SECURITY **9 hours**	
End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	
REFERENCES	
1. Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press. Edition 2010. 2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011) 3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13th November, 2001) 4. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd. 5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers. 6. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd. 7. Fundamentals of Network Security by E. Maiwald, McGraw Hill	

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Jaichandran	Assistant professor G-II	CSE	rjaichandran@avit.ac.in

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		Category	L	T	P	Credit
34721O01	DESIGN OF ELECTRONIC EQUIPMENT	OE-EA	3	0	0	3

PREAMBLE

The objective of this course is to sensitise a registrant to various aspects of an electronics product. Specifically on non-Electrical aspects like mechanical design and detailing. Starting from a need translated into specifications, leading to design and prototyping and ending up in a manufacturable physical prototype.

PREREQUISITE –Nil

COURSE OBJECTIVES

1	To understand the various Concept of Industrial Design process.
2	To apply the basic Concept of electronic Product designs methodology.
3	To classify the Concept of Ergonomics & aesthetics in product design.
4	To understand the Knowledge regarding the design of product packaging and working environment.
5	To understand the Knowledge of different industrial standard and value analysis.

COURSE OUTCOMES

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

CO1. Visualize the concept for product design with respect to ergonomics and aesthetics.	Remember
CO2. Analyze, design and implement control panels of electronic equipment	Apply
CO3. Apply creativity in the design of system by formulating architecture with proper placement of components.	Apply
CO4. Apply the concept of visual communication techniques in product design.	Apply
CO5. Apply the process of value analysis in existing product.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	S	-	-	L	M	L	-	-	S	-	-
CO2	M	L	-	M	S	-	-	L	M	L	-	-	S	-	-
CO3	M	L	-	M	S	-	-	L	M	L	-	L	S	-	M
CO4	S	M	L	-	S	-	-	L	M	L	-	L	S	M	M
CO5	S	M	L	-	S	-	-	M	L	L	-	L	S	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

MODULE 1: INTRODUCTION

Introduction to industrial design, Role of industrial design in the domain of industry, Generic product development process, ID process, Product innovations, tools and methods.

MODULE 2: PRODUCT PROTOTYPES

Management of ID process, Product architecture, Structure: standard and non-standard structures. Product prototypes.

MODULE 3: PRODUCT DESIGN AND PLANNING

Electronic product design and development Methodology, Creativity techniques, brainstorming documentation. Product planning: Defining the task, scheduling the task and its execution. Costing and Pricing of Industrial design,

MODULE 4: ERGONOMICS

Ergonomics: Ergonomics of electronic equipment, Ergonomics of control panel design. Use of ergonomics at work places and plant layout. Aesthetics: Elements of aesthetics, aesthetics of control panel design.

MODULE 5: CASE STUDIES

Value engineering, Product quality and design management. Industrial standards, Graphics and packaging

TEXTBOOKS:

1. Carl T. Ulrich, Steven. D. Eppinger," "Product Design and Development", McGraw Hill Companies.

REFERENCE BOOKS:

1. Ernest J Mccormick ,"Human factors in Engineering and Design" -, McGraw-Hill Co.

2. Yammiyavar P," Control Panel Design and Ergonomics", CEDT/IISc Publication.

3. Murrell K, Chapman," Ergonomics: Man in his Working Environment", &Hall. London. Flurschiem C H, "Industrial Design and Engineering Design ", Council, London and Springer Verlag, 1983

COURSE DESIGNERS

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2	Dr. L.K.Hema	Prof. & Head/ ECE	ECE	hodece@avit.ac.in
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34721O02	**INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS**	**Category**	**L**	**T**	**P**	**Credit**
		OE-EA	**3**	**0**	**0**	**3**

PREAMBLE

Industry 4.0 and Industrial Internet of Things is the pioneer of today's modern technology. To match the engineering skills with the industry skills this subject will induce and impart the knowledge among the young professionals.

PREREQUISITE

Basic knowledge of computer and internet

COURSE OBJECTIVES

1	Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.
2	Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.
3	Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems.
4	IIoT links the automation system with enterprise, planning and product lifecycle.
5	Real case studies

COURSE OUTCOMES

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

CO1. Apply & Analyzing the transformation of industrial process by various techniques.	Analyze
CO2. Evaluate the transformation technologies are considered to be the different drivers.	Apply
CO3. Existing industrial systems will adopt the applications of IIoT.	Apply
CO4. Intensive contributions over automation system with enterprise, planning and product life cycle	Analyze
CO5. Analyze of various Real time case studies.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	M	-	M	-	-	-	-	-	-	M	S	M	-
CO2	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO3	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO4	S	S	S	M	M	-	-	-	-	-	-	M	S	M	M
CO5	S	S	S	S	M	-	-	-	-	-	-	M	S	M	M
S- Strong; M-Medium; L-Low															

SYLLABUS

INTRODUCTION TO INDUSTRY 4.0 ANDINDUSTRIAL INTERNET OF THINGS Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II. Industry 4.0: Globalization, The Fourth Revolution, LEAN Production Systems, Cyber Physical Systems and Next Generation Sensors, Collaborative Platformand Product Lifecycle Management

INDUSTRIAL INTERNET OF THINGS& IT'S LAYERS

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation. IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II.

IIoT COMMUNICATION

Communication-Part I, Industrial IoT- Layers: IIoT Communication, IIoT Networking-Part I, Part II, Part III. Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT

IIoT BIG DATA & SDN APPLICATIONS

Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains. Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

APPLICATIONS & REAL TIME CASE STUDIES

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies - Virtual reality lab, Manufacturing industries – part one, Manufacturing industries – part two, Milk processing and packaging industries, Steel technology lab, Student projects – part one, Student projects – part two

TEXT BOOKS:

1. Anandarup Misra, Sudip | Roy, Chandana | Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0, CRC press, 2003.

REFERENCE BOOKS:

1. Gilchrist, Alasdair, "Introduction to IoT", Apress, 2016
2. Gilchrist, Alasdair "IIoT Reference Architecture", Apress, 2016

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. L.K.Hema	Prof.&Head/ECE	ECE	hodece@avit.ac.in
2	Dr.T.Muthumanickam	Professor	ECE	hodece@vmkvec.edu.in

		Category	L	T	P	Credit
34621O01	**GREEN POWER GENERATION SYSTEMS**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

The course presents the various sources of renewable energy including wind, solar, and biomass as potential sources of energy and investigates the contribution they can make to the energy profile of the nation. The technology used to harness these resources will be presented. Discussions of economic, environment, politics and social policy are integral components of the course.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	Understand the nexus between energy, environment, and sustainable development.
2	Appreciate energy ecosystems and its impact on environment.
3	Learn basics of various types of renewable and clean energy technologies..
4	Serve as bridge to advanced courses in renewable energy.

COURSE OUTCOMES

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

CO1: Explain renewable energy sources & systems.	Understand
CO2: Apply engineering techniques to build solar, wind, tidal, geothermal, biofuel, fuel cell, Hydrogen, and sterling engine.	Apply
CO3: Analyze and evaluate the implication of renewable energy. Concepts in solving numerical problems pertaining to solar radiation geometry and wind energy systems.	Analyze
CO4: Demonstrate self -learning capability to design & establish renewable energy systems.	Analyze
CO5: Conduct experiments to assess the performance of solar PV, solar thermal and biodiesel systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	M	-	L	L	-	-	-	-	M	-	-
CO2	S	M	S	L	M	-	L	M	-	M	-	-	-	-	-
CO3	S	-	-	-	M	-	-	M	M	-	-	-	L	-	-
CO4	S	-	-	-	M	-	L	-	-	-	-	M	-	-	-
CO5	S	M	S	L	M	-	L	M	-	M	M	-	M	L	-
CO6	S	-	-	-	M	-	L	L	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

ENERGY

Introduction to the nexus between energy, environment and sustainable development, Energy sources overview and classification, sun as the source of energy, fossil fuel reserves and resources - overview of global/ India's energy scenario. Energy consumption models – Specific Energy Consumption

ECOLOGY AND ENVIRONMENT

Concept and theories of ecosystems, - energy flow in major man-made ecosystems- agricultural, industrial and urban ecosystems - sources of pollution from energy technologies and its impact on atmosphere - air, water, soil, and environment - environmental laws on pollution control, The environmental protection act: Effluent standards and ambient air quality, innovation and sustainability, eco-restoration: Phyto-remediation.

RENEWABLE SOURCES OF ENERGY

Solar Energy: Solar radiation: measurements and prediction. Indian's solar energy potential and challenges, solar energy conversion principles and technologies: Photosynthesis, Photovoltaic conversion, and Photo thermal energy conversion. Wind Energy: Atmospheric circulations, atmospheric boundary layers, classification, factors influencing wind, wind shear, turbulence, wind energy basics and power Content, wind speed monitoring, Betz limit, wind energy conversion system: classification, characteristics, and applications. Ocean Energy: Ocean energy resources-ocean energy conversion principles and technologies: ocean thermal, ocean wave & ocean tide

BIOENERGY

Biomass as energy resources; bio-energy potential and challenges, Classification, and estimation of biomass; Source and characteristics of biofuels: Biodiesel, Bioethanol, Biogas. Types of biomass energy conversion systems - waste to energy conversion technologies

OTHER ENERGY SOURCES AND SYSTEMS

Hydropower, Nuclear fission, and fusion-Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; hydrogen energy, Magneto-hydro-dynamic (MHD) energy conversion – Radioisotope Thermoelectric Generator (RTG), Bio-solar cells, battery & super capacitor, energy transmission and conversions.

TEXTBOOKS:

1. Energy and the Environment, Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A., 2nd Edition, John Wiley, 2006,
2. Energy and the Challenge of Sustainability, World Energy assessment, UNDP, N York, 2000.

REFERENCE BOOKS:

1. Ocean Energy: Tide and Tidal Power by R. H. Charlier and Charles W. Finkl, Springer 2010
2. Introduction to Electrodynamics (3rd Edition), David J. Griffiths, Prentice Hall, 2009

COURSE DESIGNERS

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2	Mr. R. Sathish	Assistant Professor	EEE	sathish@vmkvec.edu.in
3	Mr. V.Rattankumar	Assistant Professor	EEE	rattankumar@avit.ac.in

		Category	L	T	P	Credit
34621O02	**INDUSTRIAL DRIVES AND AUTOMATION**	**OE-EA**	**3**	**0**	**0**	**3**

Preamble

To introduce foundation on the principles of drives & automation and their elements with the implementation.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To explore the various AC,DC & Special Machine Drives for industrial Application.
2	To study about the various Open loop and closed loop control schemes for drives.
3	To know about hardware implementation of the controllers using PLC.
4	To study the concepts of Distributed Control System.
5	To understand the implementation of SCADA and D.CS

COURSE OUTCOMES

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

CO1	To understand working principles of various types of motors, differences, characteristics and selection criteria.	Understand
CO2	To apply the knowledge in selection of motors, heating effects and braking concepts in various industrial applications	Apply
CO3	To explain control methods of special drives	Understand
CO4	To carry out programming using PLC and use of various PLCs to Automation problems in industries.	Understand
CO5	To discuss supervisory control and data acquisition method and use the same in complex automation areas	Understand
CO6	To understand and use logical elements and use of Human Machine Interfacing devices to enhance control & communication aspects of Automation	Understand

Mapping with Programme outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	L	-		S	S	-		L	-	-	-	-	L
CO2	M	-	M	-	S	L	M	-	M	L	-	-	L	-	-
CO3	M	-	M	-	S	L	M	-		L	-	-	-	M	-

CO4	S	-	S	-	S	M	M	L	-	L	M	-	-	-	L
CO5	S	M	S	S	S	M	S	-	M	L	L	M	-	L	M

SYLLABUS

INTRODUCTION

Working principle of synchronous, Asynchronous & stepper motors, Difference between Induction and servo motors, Torque v/s speed characteristics, Power v/s. Speed characteristics, Vector duty induction motors, Concepts of linear and frameless motors, Selection of feedback system, Duty cycle, , V/F control, Flux Vector control.

INDUSTRIAL DRIVES

Electric drive – Definition – Parts – Types -Individual – Group – Multi motor. Stepper motor – Definition – Step angle – Slewing rate -Types -Variable reluctance -Hybrid – Closed loop control of stepper motor – Drive system(any one) – logic sequencer – Optical encoder. Servo motor – Definition – Types -DC servo motor – Permanent magnet DC motors – Brushless motor – AC servo motor -Working of an AC servo motor in control system – Induction motors – Eddy current drive for speed control of induction motors.

PROGRAMMABLE LOGIC CONTROLLER

Definition Conventional Hard wired logicRelays- Features of PLC- Advantages of PLC over relay logic – Block diagram of PLC -Programming basics of PLC – Ladder logic -Symbols used in ladder logic – Logic functions – Timers – Counters – PLC networking – Steps involved in the development of Ladder logic program – Program execution and run operation by PLC – Ladder logic diagram for liquid level operation. List of various PLCs and their manufactures.

DISTRIBUTED CONTROL SYSTEM

Evolution of distributed control system -Definition of DCS – Functional elements of DCS – Elements of local control unit -Interfaces-Types of information displays – Architecture of anyone commercial DCS – Advantages of DCS -Selection of DCS – List of various DCS and their manufactures.

SUPERVISORY CONTROL & DATA ACQUISITIONS

Introduction to Supervisory control & data Acquisitions, distributed Control System (DCS): computer networks and communication in DCS. different BUS configurations used for industrial automation – GPIB, HART and OLE protocol, Industrial field bus – FIP (Factory Instrumentation Protocol), PROFIBUS (Process field bus), Bit bus. Interfacing of SCADA with controllers, Basic programming of SCADA, SCADA in PC based Controller / HMI.

TEXTBOOK

1. 1. G.K.Dubey, Fundamentals of Electrical Drives', Narosa Publication,2002.
2. FrankD.petruzellaprogrammable logic controlsthird edition TATA mc graw-hill edition 2010.
3. M.S.Berde, Electric Motor Drives Khanna publishers.2008

REFERENCES

1. Pradheepkumarsrivastava, Programmable logic controllers with applications', BPB publications.2004.
2. John W.Webb, Ronald A.Reis, Programmable logic controllers-Principles and Applications', Fifth Edition, Prentice Hall of India.
3. Michel P.Lukas, Distributed Control system', van Nostrand Reinhold Co, 1986
4. R.SrinivasanSpecial electrical Machines lakshmi publication.2012
5. Process Control Instrumentation Technology, Johnson Curties, Prentice hall of India, 8th edition
6. Andrew Parr, Industrial drives, Butterworth – Heineaman

COURSE DESIGNERS

Sl No	Name of the Faculty	Designation	Department	Mail ID
1	Dr.L.Chitra	Professor	EEE/AVIT	chitra@avit.ac.in
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		Category	L	T	P	Credit
36921O01	BIOMOLECULES-STRUCTURE AND FUNCTION	OE-EA	3	0	0	3

PREAMBLE

Biomolecules like carbohydrates, proteins, fat are vital components of any living system. Basic knowledge about them helps in maintaining a healthy lifestyle, free of sickness and a general awareness about hygiene.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To give an overview of importance of biomolecules.
2	To elaborate the structure of proteins and nucleic acids and its role in disease.
3	To enumerate the role of carbohydrates and their cellular function in physiology and pathology.
4	To enumerate the role of lipids and their cellular function in physiology and pathology.
5	To briefly cholesterol and its role in diseases.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Relate the basics of biomolecules in and around him	Understand
CO2. Understand the structure of biomolecules such as proteins and nucleic acids	Understand
CO3. Discover the role of carbohydrates in healthy and diseased conditions	Apply
CO4. Relate disfunctioning of lipids with disease	Analyse
CO5. Criticize the role of cholesterol in diseases.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L	-	-	L	-	-	-	-	-	-	-	L	-
CO2	S	M	S	-	-	M	-	-	-	-	-	-	-	L	-
CO3	M	L	M	M	-	S	-	-	-	-	-	-	-	L	-
CO4	L	L	L	L	S	L	-	-	S	-	-	M	L	M	M
CO5	S	-	L	L	-	M	-	-	-	-	-	S	S	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

PROTEINS

Protein – Structure – primary, secondary, tertiary. Types of proteins and their function. Role of each type of Protein in Health and Disease.

NUCLEIC ACIDS

Nucleic Acids – Components of nucleic acids, Conformational parameters. Nucleic acids – Types of DNA and RNA. DNA Polymorphism, Circular DNA, Supercoil DNA, DNA-Protein interactions. Role of nucelic acids in Health and disease

CARBOHYDRATES

Carbohydrates – Introduction. Types – monosaccharide, disaccharide, oligosaccharide and polysaccharides. Structure of each type. Artificial sugars. Role of carbohydrates in Health and Disease

FATTYACIDS AND LIPIDS

Fatty acids- Introduction, nomenclature, types - Saturated and unsaturated fatty acids, Essential and non-essential fatty acids.

Lipids – Introduction, Classification - simple and compound lipids, phospholipids, Cholesterol and its role in health and disease, Micelles and Liposomes : Applications in biology and medicine

CELL MEMBRANE AND CELL SIGNALING

Cell membrane - components and architecture, Various membrane models including Fluid-mosaic model. Ion channels, Receptors, Signaling molecules, Signaling mechanism, Role of cell signaling in Health and Disease. Inter-relationship of biomolecules.

TEXTBOOKS

1. Biophysical Chemistry, Part II, Techniques for the study of biological structure and function, by Cantor C.R. and Schimmel P R., W.H. Freeman and Company, 1980.

2. Nucleic Acids in chemistry and Biology, by Blackburn G.M. and gait M.J., IRL Press, 1990.

3. Biochemistry, by Voet D. and Voet J.G., John Wiley and sons, 1995.

4. Physical Biochemistry, by Freifelder D., W.H. Freeman and company, 1976-1982.

COURSE DESIGNERS

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		Category	L	T	P	Credit
36921O02	**PHARMACOGENOMICS**	**OE-EA**	**3**	**0**	**0**	**3**

PREAMBLE

Pharmacogenomics involves the study of the relationship between an individual's genetic makeup and his or her response to a drug. Pharmacogenetics, a component of pharmacogenomics, is the study of the relationship between a single gene and its response to a drug.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	Discuss about the basic knowledge about pharmacogenomics and drug design using genomic applications for drug action and toxicity.
2	Perform how individualization of drug therapy can be achieved based on a person's genetic makeup while reducing unwanted drug effects.
3	Outline the Pharmacogenomics studies on how genetic differences between individuals can affect responses to various drugs.
4	Formulate on medicine skills acquired by the student and his action in different pathologies
5	Develop acquire knowledge about the influence of genetic alterations on the therapeutic effect and adverse reactions of the drugs, from a perspective of individualized therapy.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1.Recognize the effect of genetic differences between individuals in the outcome of	Remember
CO2. Describe the role of single nucleotide polymorphism as a biomarker for the	Understand
CO3. Utilize and manage the new genomics based tools as they become available as	Understand
CO4. Examine the applications of genomics principles in drug action and toxicology	Analyze
CO5. Validation of case studies related to pharmacogenomics	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES															
COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	L	L	L	L	L	L	L	-	L	L	L	L	L	L	
CO2	M	M	M	M	L	-	-	-	M	-	L	L	L	L	-
CO3	S	S	S	S	L	-	-	-	M	-	L	L	L	L	-
CO4	M	M	M	M	M	-	-	-	S	-	L	L	M	L	-
CO5	L	L	L	L	S	-	-	-	M	-	M	M	S	M	-
S- Strong; M-Medium; L-Low															

SYLLABUS

PHARMACOGENOMICS AND PERSONALIZED MEDICINE

Pharmacogenetics - Roots of pharmacogenomics and it is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development. Concept of individualized drug therapy, Drivers and the promise of personalized medicine, Strategies for application of pharmacogenomics to customize therapy, Barriers.

HUMAN GENOME

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the outcome of host pathogen interactions, Protein coding genes, repeat elements, genome duplication, analysis of proteome, DNA variation, Biological complexity. Single nucleotide polymorphisms (SNP's) in Pharmacogenomics - approaches, number and types of SNPs, Study design for analysis, Analytical issues, Development of markers.

ASSOCIATION STUDIES IN PHARMACOGENOMICS

Viability and Adverse drug reaction in drug response, Multiple inherited genetic factors influence the outcome of drug treatments, Association studies in pharmacogenomics, Strategies for pharmacogenomics Association studies, Benefits of Pharmacogenomics in Drug R & D.

GENOMICS APPLICATIONS FOR DRUG ACTION, TOXICITY AND DESIGN

Platform technologies and Pharmaceutical process, its applications to the pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization, safety and toxicology studies. The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in

the ligand binding pocket.

PHARMACOGENOMICS – CASE STUDIES

Study of pharmacogenomics of human P-Glycoprotein, drug transporters, lipid lowering drugs, chemotherapeutic agents for cancer treatment.

TEXT BOOKS

1. Martin M. Zdanowicz, M.M. “Concepts in Pharmacogenomics” Second Edition, American Society of Health-System Pharmacists, 2017.
2. Licinio, J and Wong, Ma-Li. “Pharmacogenomics: The Search for the Individualized Therapies”, Wiley-Blackwell, 2009.
3. Yan Q, “Pharmacogenomics in Drug Discovery and Development” Humana Press, 2nd Edition, 2014.

REFERENCES

1. Brazeau, D.A. and Brazeau, G.A. “Principles of the Human Genome and Pharmacogenomics” American Pharmacist Association, 2011
2. Werner, K., Meyer, U.A., Tyndale, R.F. “Pharmacogenomics”, Second Edition, Taylor and Francis, 2005.
3. Langman, L.J. and Dasgupta, A. "Pharmacogenomics in Clinical Therapeutics", Wiley – Blackwell, 2012

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Ms. R. Jaishri	Assistant Professor	Pharmaceutical Engineering	jaishri@vmkvec.edu.in

MANDATORY COURSES

Course Code	Course Title	Category	L	T	P	C
34121Z81	YOGA AND MEDITATION	AC	0	0	2	0

OBJECTIVES:

Yoga is derived from a Sanskrit word 'yuj' which loosely means 'union.' It is a path through which an individual unites with the entire existence. Sounds heavy, right? It basically means how you are not a separate entity but part of a greater energy. It increases your consciousness and makes you realize your true self-clearing the clutter of all that you imbibed as part of your culture, family, and education. It makes you realize that there is something more than what you see around. It is a deeply spiritual practice that is part philosophy, religion, science, and exercise.

COURSE CONTENT

- Surya namaskar,Padmasana, Uttakatasana
- Surya pranayama, BrahmariPranayama
- Anjalimudra, Mahamudra, Chin Mudra
- Kapalabathikriya,Bhastrika, Tratakkriya
- Simple Meditation,YogaBreath awareness meditation,.

OUTCOMES :

- It incorporates breathing exercises, meditation and poses designed to encourage relaxation and reduce stress.
- Practicing yoga is said to come with many benefits for both mental and physical health.
- Yoga is known for its ability to ease stress and promote relaxation.
- Many people begin practicing yoga as a way to cope with feelings of anxiety.
- Could Improve Heart Health
- Improves Quality of Life.
- Could Promote Sleep Quality.
- Improves Flexibility and Balance.
- Could Help Improve Breathing.
- Promotes Healthy Eating Habits.
- Can Increase Strength.

TEXT BOOK:

YogacharyaSundaram, *Sundra Yoga Therapy*, Asana Publications, 2009

REFERENCES:

1. Dr.V.Krishnamoorthy, *Simple Yoga for Health*, Sri MathiNilayam, 2012.
2. Dr.AnandaBalayogiBhavanani, *A Primer of Yoga Theory*, Dhivyananda Creations,2008.
3. Dr.S.Hema, Easy *Yoga for Beginners*, Tara yoga Publications,2008.
4. Dr.AsanaAndiappan, *Ashtanga Yoga*, Asana Publications, 2009.
5. Dr.JohnB.Nayagam, *MudumaikkuMutrupulliVaikkumMuthiraigal*, SaaruPrabha Publications, 2010.

Course Code	Course Title	category	L	T	P	C
34121Z84	INDIAN CONSTITUTION	AC	0	0	2	0

Course Objectives:

On completion of this course, the students will be able:

1 To understand the nature and the Philosophy of the Constitution.

2 To understand the outstanding Features of the Indian Constitution and Nature of the Federal system.

3 To Analyse Panchayat Raj institutions as a tool of decentralization.

4 To Understand and analyse the three wings of the state in the contemporary scenario.

5 To Analyse Role of Adjudicatory Process.

5 To Understand and Evaluate the recent trends in the Indian Judiciary.

Course Content

UNIT I

The Constitution - Introduction

The Historical background and making of the Indian Constitution –Features of the Indian Constitution- Preamble and the Basic Structure - Fundamental Rights and Fundamental Duties –Directive Principles State Policy

UNIT II –Government of the Union

The Union Executive- Powers and duties of President –Prime Minister and Council of Ministers - Lok Sabha and Rajya Sabha

UNIT III –Government of the States

The Governor –Role and Powers - Cheif Minister and Council of Ministers- State Legislature

UNIT IV – Local Government

The New system of Panchayat, Municipalities and Co-Operative Societies

UNIT V – Elections

Powers of Legislature -Role of Chief Election Commissioner-State Election Commission

TEXTBOOKS AND REFERENCE BOOKS:

1 Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008

2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)

3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Fourth 2020 edition Suggested.

Total Hours: 30 hours

Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of india/

Alternative NPTEL/SWAYAM Course:

S.NO	NPTEL ID	NPTEL Course Title	Course Instructor
1	12910600	CONSTITUTION OF INDIA AND ENVIRONMENTAL GOVERNANCE: ADMINISTRATIVE AND ADJUDICATORY PROCESS	PROF. M. K. RAMESH NATIONAL LAW SCHOOL OF INDIA UNIVERSITY

COURSE DESIGNER

S.NO	NAME OF THE FACULTY	DESIGNATION	NAME OF THE INSTITUTION	MAIL ID
1	Dr.Sudheer	Professor	AV School of Law	Sudheersurya18@gmail.com

Course Code	Course Title	Category	L	T	P	C
34121Z83	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**	AC	0	0	2	0

Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes:

At the end of the Course, Student will be able to:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. Illustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

UNIT-I:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-2:

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-3:

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-5:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation

and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:

1.https://www.youtube.com/watch?v=LZP1StpYEPM

34121Z82	Gender Equity and Law (Common to all Branches)	Category	L	T	P	Credit
		AC	0	0	2	0

Gender Equity is the provision of fairness and justice in the distribution of benefits and responsibilities between Men, Women, Transgender, and Gender non-binary individuals. Gender equity is important because, historically, societies around the world have deemed females, transgender people, and nonbinary people as "weaker" or less important than males. Gender equity emphasizes respecting individuals without discrimination, regardless of their gender. There are legal provisions thataddress issues like inequalities that limit a person's ability to access opportunities to achieve better health, education, and economic opportunity based on their gender.

PREREQUISITE: NIL

COURSE OBJECTIVES

1	To sensitize the students regarding the issues of gender and thegender inequalities prevalent in society.
2	To raise and develop social consciousness about gender equity among thestudents.
3	To build a dialogueand bring a fresh perspective on transgender and gender non-conforming individuals.
4	To create awareness among the students and to help them face gender stereotype issues.
5	To help the studentsunderstand the various legal provisions that are available in our society.

COURSE OUTCOMES

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

CO1.Understand the importance of gender equity	Understand
CO2.Initiate the awareness and recognize the social responsibility with regards to gender equity.	Apply
CO3.To develop a sense of inclusiveness and tolerance towards various genders without any discrimination.	Apply
CO4. To evaluate the social issues and apply suitable gender-related regulations for inclusive living.	Evaluate
CO5.To identify and analyze the existing gender inequality problems faced in various institutions.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	S	S	S	-	-	-	S	-	-	-

CO2	S	M	M	-	-	S	S	S	-	-	-	S	-	-	-
CO3	S	L	M	-	-	S	S	S	-	-	-	S	-	-	-
CO4	S	S	S	L	-	S	S	S	-	-	-	S	-	-	-
CO5	S	S	S	M	-	S	S	S	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT –I INTRODUCTION TO GENDER AND SEX

6hrs

Definition of Sex – Definition of Gender - Sex Vs. Gender - Social Construction of Gender and Gender Roles – GenderStereotypes - Gender Division of Labour - Patriarchy, Masculinity and Gender Equality -Feminism and Patriarchy.

UNIT –II - GENDER BIAS

6 hrs

Introduction to Gender Inequality in India - Gender Bias in Media - Misleading Advertisement And

Poor Portrayal of Women and gender non-conforming individuals- Objectification of Women, Transgender, and gender non-conforming individuals - Differential Treatment of Women, Transgender, Exploitation Caused by Gender Ideology - Female Infanticide - Honor Killing.

UNIT –III GENDER SENSITIZATION AND INTERNATIONAL CONVENTIONS 6 hrs

Gender Sensitization -Need and Objective - Gender Sensitivity Training at Workplace – GenderSensitization in Judiciary - Gender Sensitization in School Curriculum.

UNIT-IV - SEXUAL OFFENCES AGAINST WOMEN 6 hrs

Indian Penal Code, 1860 - S., 304B, 354, 354C, 354d, 376, 498A & 509 - The ImmoralTrafficPrevention Act 1986 - The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 - Protection of Women from Domestic Violence Act, 2005- Indecent Representation of Women Act, 1986**.**

UNIT-V ROLE OF GOVERNMENT FOR INCLUSIVE DEVELOPMENT

6hrs

Initiatives of NCERT -Role of Ministry of Women and Child Development - Governmental Initiatives: Beti BachaoBeti Padhao (BBBP) - Ujjawala Scheme - Working Women Hostels (WWH), National Council for Transgender Persons.

TEXT BOOKS

1. IGNOU: Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi IGNOU
2. Jane Pilcher and Imelda Whelehan (2005): Fifty Key Concepts in Gender Studies

REFERENCES:

1. Women's Empowerment & Gender Parity: @Gender Sensitization, Dr. Shikha Bhatnagar, Repro Books (2020).

2. Gender Sensitization: Issues and Challenges, Anupama Sihag Raj Pal Singh, Raj Publications (2019).

3. Violence Against Women: Current Theory and Practice in Domestic Abuse, Sexual Violence, andExploitation (Research Highlights in Social Work), Jessica Kingsley Publishers (2012).

4. Gill, Rajesh, Contemporary Indian Urban Society- Ethnicity, Gender and Governance, BookwellPublishers, New Delhi (2009).

5. Sexual Violence Against Women: Penal Law and Human Rights Perspectives, Lexis Nexis (2009) 6. Chatterjee, Mohini, Feminism and Gender Equality, Aavishkar, Jaipur,2005.

7. Mies, Maria, Indian Women and Patriarchy, Concept Publishing Company, New Delhi, 2004.

COURSE DESIGNERS

S.No.	Name of the Faculty	Mail ID
1	Gnana Sanga Mithra.S	sangamithra@avil.edu.in
2	Aarthy.G	aarthy@avil.edu.in

ELECTIVE COURSES SPECIALIZATION-3D PRINTING AND DESIGN

344213D01	**CAD FOR ADDITIVE MANUFACTURING**	**Category**	**L**	**T**	**P**	**Credit**
		EC-SE	**3**	**0**	**0**	**3**

Preamble

The course is designed to impart knowledge and skills related to CAD and itsapplications in additive layer Manufacturing.

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and techniques related to CAD and its application in AM.
2	To construct a CAD model using curves.
3	To Develop a CAD model using surfaces.
4	To construct a CAD using solids.
5	To identify the various data exchange formats and CAD applications.

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

CO1.	Demonstrate the various design using CAD	Understand
CO2.	Develop CAD Model using different forms of curves	Apply
CO3.	Develop CAD Model using different forms of surfaces	Apply
CO4.	Develop CAD Model using different solid modeling techniques	Apply
CO5.	Able to identify the various CAD exchange formats and CAD applications	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	S	M	-	L	-	-	-	-	-	-	-	S	-	-
CO3	S	M	-	-	L	-	-	-	-	-	-	-	M	-	L
CO4	L	S	-	-	L	-	-	-	-	-	-	-	S	-	L
CO5	S	M	L	M	-	L	-	-	-	-	-	-	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS

2D & 3D TRANSFORMATIONS OF GEOMETRY

Translations, Scaling, Reflection, Rotation, Homogeneous representation of transformation, Concatenation of transformations, Perspective, Axonometric projections, Orthographic and

DESIGN OF CURVES

Analytic Curves, PC curve, Ferguson, Composite Ferguson, curve Trimming and Blending, Bezier segments, de Casteljau's algorithm, Bernstein polynomials, Bezier- subdivision, Degree elevation, Composite Bezier, Splines, Polynomial Splines, B-spline basis functions, Properties of basic functions, Knot Vector generation, NURBS.

DESIGN OF SURFACES

Differential geometry, Parametric representation, Curves on surface, Classification of points, Curvatures, Developable surfaces, Surfaces of revolution, Intersection of surfaces, Surface modeling, 16-point form, Coons patch, B-spline surfaces.

DESIGN OF SOLIDS

Solid entities, Boolean operations, B-rep of Solid Modeling, CSG approach of solid modeling, Advanced modeling methods.

DATA EXCHANGE FORMATS AND CAD APPLICATIONS

Data exchange formats, reverse engineering, modeling with point cloud data, Rapid prototyping,3D Scanning and Digitizing Devices, CAD Model Construction from Point Clouds, Data handling & Reduction Methods, Tessellated Models, STL File Problems, STL File Manipulation and Repair Algorithms Part orientation and support generation, Slicing Algorithms, Tool path generation, Multi-material representation in AM

Text Books

1	Ibrahim Zeid "CAD/CAM Theory and Practice" TMH, 2009.
2	Anupam Saxena, Birendra Sahay, "Computer Aided Engineering Design", Springer, 2005.

Reference Books

1	Michael E. Mortenson, "Geometric Modeling", Wiley Computer publishing, NY, 1997.
2	Ian Gibson, "Software Solutions for Rapid Prototyping", Professional EngineeringPublishing Limited, UK, 2002.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.L.Prabhu	Associate Professor	Mech / AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

344213D02	POWDER METALLURGY	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble
This course provides basic knowledge in various techniques in Powder Metallurgy. The different methods and procedures are included in the syllabus.

Prerequisite – Nil

Course Objectives

1	Classify the different powders and the preparation techniques.
2	Perform the characterization of different powders.
3	Explain the different powder shaping techniques.
4	Explain the sintering processes.
5	Apply the techniques for the required applications.

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

CO1	Classify powder preparation techniques.	Understand
CO2	Identify the characterization techniques for powder.	Understand
CO3	Differentiate between conventional powder compaction and modern compaction techniques.	Understand
CO4	Explain the mechanism of sintering theory and techniques.	Understand
CO5	Apply powder metallurgical techniques for mechanical components.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	-	M	-	M	-	-	-	-	-	-	M	-	-
CO2	M	S	-	S	-	M	-	-	-	-	-	-	M	-	-
CO3	M	S	-	M	-	L	-	-	-	-	-	-	S	-	-
CO4	L	M	-	M	-		-	-	-	-	-	-	S	-	L
CO5	M	M	-	M	-		-	-	-	-	-	-	S	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

General Concepts: Introduction and History of Powder Metallurgy (PM), Present and Future Trends of PM- Powder Production Techniques: Different Mechanical and Chemical methods, Atomization of Powder, other emerging processes, Performance Evaluation of different Processes, Design & Selection of Process.

CHARACTERISATION

Characterisation Techniques: Particle Size & Shape Distribution, Electron Microscopy of Powder, Interparticle Friction, Compressionability, Powder Structure, Chemical Characterization

POWDER SHAPING

Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process Variables, Pressure & Density Distribution during Compaction, Isostatic Pressing, Injection Molding, Powder Extrusion, Slip Casting, Tape Casting, Analysis of Defects of Powder Compact, Laser Engineering Net Shaping (LENS)

SINTERING

Sintering: Theory of Sintering, Sintering of Single & Mixed Phase Powder, Liquid Phase Sintering, Sintering Variables, Modern Sintering Techniques, Physical & Mechanical Properties Evaluation, Structure-Property Correlation Study, Modern Sintering techniques, Defects Analysis of Sintered Components

APPLICATIONS

Application of Powder Metallurgy: Filters, Tungsten Filaments, Self-Lubricating Bearings,Porous Materials, Biomaterials etc.

Text Books

1	P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008.
2	ASM Hand Book, vol. 7: Powder Metallurgy, ASM International.

Reference Books

1	G.S.Upadhyaya Powder Metallurgy Technology, Cambridge International Science Publishing, 2002.
2	J. S. Hirschhorn: Introduction to Powder Metallurgy, American Powder Metallurgy Institute, Princeton, NJ, 1976

Course Designers

S.No	Faculty Name	Designation	Department/ Name of the College	Email id
1	Dr.L.Prabhu`	Associate Professor	Mech / AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
344213D03	ADDITIVE MANUFACTURING IN MEDICAL APPLICATIONS	EC-SE	3	0	0	3

Preamble

The course is designed to impart knowledge and discuss about the role of additive manufacturing in medical applications

Prerequisite – Nil

Course Objectives

1	To understand the procedure involved in 3D data capture
2	To discuss role of bio modeling and virtual models in medicine.
3	To identify various biomaterials and its applications.
4	To develop the bio implants and medical devices.
5	To design and develop the medical devices.

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

CO1.	Know the procedure involved in 3D data capture and processing	Understand
CO2.	Apply various virtual model and bio modeling in medicine	Apply
CO3.	Know about the various biomaterials and its applications.	Apply
CO4.	Develop various bioimplants using biomaterials	Apply
CO5.	Able to design and develop the medical devices.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1	PO 11	PO 12	PS O 1	PS O 2	PS O 3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	S	M	-	M	-	-	-	-	-	-	-	S	-	-
CO3	M	S	L	-	M	-	-	-	-	-	-	-	L	-	-
CO4	M	L	-	-	L	-	-	-	-	-	-	-	M	-	-
CO5	M	L	M	M	-	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

3 DIMENSIONAL DATA CAPTURE AND PROCESSING

Introduction to medical imaging, X-Ray technology, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound imaging, 3-D laser scanners, Industrial CT Scanners, 3D reconstruction and Reverse Engineering (RE)

BIO-MODELLING AND VIRTUAL MODELS IN MEDICINE

Surgical applications of virtual models in Cranio-maxillofacial biomodelling, Oral and Maxillofacial surgery, customized cranio- maxillofacial prosthetics, Biomodel-guided stereotaxy, Vascular biomodelling, Skull-base tumour surgery, Spinal surgery and Orthopaedic biomodelling.

BIOMATERIALS

Introduction to biomaterials, metallic biomaterials, ceramic biomaterials, polymeric biomaterials, composite biomaterials, biodegradable polymeric biomaterials, tissue- derived biomaterials

DESIGN AND FABRICATION OF CUSTOMIZED IMPLANTS AND PROSTHESIS

Cranium implants, Hip implants, Knee implants, Inter vertebral spacers, Buccopharyngealstent, Tracheobronchial stents, Obturator prosthesis and Tissue engineering scaffolds.

DESIGN AND PRODUCTION OF MEDICAL DEVICES

Biopsy needle housing, Drug delivery devices, Masks for burnt victims, Functional prototypes help prove design value.

Text Books

1	Ian Gibson, Advanced Manufacturing Technology for Medical Applications, JohnWiley, 2005.

Reference Books

1	Paulo Bartolo and Bopaya Bidanda, Bio-materials and Prototyping Applicationsin Medicine, Springer, 2008.
2	Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, RapidTooling and Rapid Manufacture, Hanser Publishers, 2013. Joseph D. Bronzino, The Biomedical Engineering Hand Book, 3rd Edition, CRC Press, 2006.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the	Email id
1	Dr.L.Prabhu	Associate Professor	Mech / AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

344213D04	RAPID TOOLING AND INDUSTRIAL APPLICATIONS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

The course is designed to impart knowledge and discuss about the rapid toolingand its industrial applications

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and techniques in rapid tooling and its process modeling
2	To develop various delivery system involved in AM machines and systems
3	To identify the indirect Methods for Rapid Tool Production and Rapid Bridge Tooling
4	To identify various roles of Rapid Tooling in advanced casting process
5	To discuss about the rapid tooling equipment in medical and automotive field

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

CO1.	Understand the various concepts and techniques in rapid tooling and its process modeling	Understand
CO2.	Apply the procedure involved in designing a delivery system in AM machines and system	Apply
CO3.	Apply the indirect Methods for Rapid Tool Production and Rapid Bridge Tooling	Apply
CO4.	Understand the various roles of Rapid Tooling in advanced casting process	Understand
CO5.	Able to construct the rapid tooling equipment in medical and automotive field	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	M	-	M	-	-	-	-	-	-	-	S	-	-
CO3	S	M	-	L	L	-	-	-	-	-	-	-	M	-	L
CO4	M	S	-	-	L	-	-	-	-	-	-	-	M	-	-
CO5	M	L	M	M	-	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO RAPID TOOLING & PROCESS MODELING

Convectional Tooling Vs. Introduction to modeling, Concurrent Rapid Product and Process Development, Finite Element Modeling and Simulation, Injection-molding, Die-casting, Blow-molding, Thermoforming Processes modeling

INDIRECT METHODS FOR RAPID TOOL PRODUCTION AND RAPID BRIDGE TOOLING

Role of Rapid Soft Tooling methods in tool production, Introduction to Bridge tooling, CAFÉ Bridge tooling, Direct AIM Rapid Bridge tooling, Rapid Tool Rapid Bridge tooling, Shrinkage Variation, Random- noise Shrinkage, Metal deposition tools, RTV tools, Epoxy tools, Ceramic tools, Cast Metal tools, Investment-cast Rapid Production tooling, Fusible metallic cores, Rapid Production tooling for Precision Sand Casting, Keltool process.

DIRECT METHOD FOR RAPID TOOL PRODUCTION

Role of direct methods in tool production, Direct ACES Injection moulds, Laminated Object Manufactured (LOM) tools, DTM Rapid Tool, Rapid Steel 1.0, Rapid Steel 2.0, Copper Polymide tools, Sand Form tools, EOS Direct Tool Process, Direct Metal Tooling using 3DP, TopographicShape Formation (TSF) tools.

THE ROLE OF RAPID TOOLING IN INVESTMENT-CASTING & SAND CASTING APPLICATIONS

Introduction, Rapid Tool Making for investment Casting, Rapid Tooling for developing Casting Applications, Sand casting Process, Tool Design and Construction for Sand Casting, Sand Casting Dimensional Control, Tooling Alternative Selection Case Studies

RAPID TOOLING IN THE MEDICAL DEVICE & AUTOMOTIVE INDUSTRY

Introduction, Investment Casting and Conventional Wax Pattern Tooling, Conventional Tooling Manufacture Vs. Rapid Tooling Manufacture, Medical Case studies like Hip Stem and Knee implants. Approaching Niche Vehicle Markets, Accelerating Product Developments, Utilizing Rapid Prototyping and Manufacturing, Machining Laminates, Rapid Prototype Stages, SubsequentCasting Operations, Rapid Tooling Developments, Case Studies.

Text Books

1	D.T.Pham and S.S Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping & Rapid Tooling, Springer, 2001.
2	Peter Hilton and Paul F Jacobs, Rapid Tooling Technologies and Industrial Applications, Marcel Dekker Inc, New York, 2001

Reference Books

1	Wanlong Wang, Henry W. Stoll and James G. Conley, Rapid Tooling Guidelines forSand Casting, Springer, 2010.
2	Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, RapidTooling and Rapid Manufacture, Hanser Publishers, 2013.

Course Designers

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		Category	L	T	P	Credit
344213D05	**POLYMER ENGINEERING**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble
This course provides basic knowledge in various Polymerisation techniques and application in engineering domain in specific to the 3D printing and design

Prerequisite – NIL

Course Objectives

1	Explain the different polymers and their properties.
2	Explain the mechanism of polymerization.
3	Explain the different methods of polymerization.
4	Explain the polymer processes for additive manufacturing.
5	Explain the designing concepts of polymeric devices and polymer additives.

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

CO1	Explain the relationship between polymer properties (thermal, rheological, mechanical), and polymer microstructure and molecular weight.	Understand
CO2	Relate polymer properties to their processing and uses for additive	Understand
CO3	Explain methods for determining the microstructure and molecular weight of polymers.	Understand
CO4	Describe different types of polymerization process, polymer processing and the significance for AM.	Understand
CO5	Understand the applications and design concepts for use of polymer in device manufacturing.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M	M	M	-	M	M	-	-	-	M	M	-	M	-	-
CO2	M	S	S	-	S	M	-	-	-	M	M	-	M	-	-
CO3	S	-	M	-	S	-	M	-	-	M	M	-	S	-	-
CO4	M		M	S	M	-	-	M	-	M	M	-	S	-	-
CO5	M	M	M	M	M	-	-	M	-	M	M	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Basic Concepts: Classification of polymers, Concept of functionality, Polydispersity and Molecular weight [MW], Molecular Weight Distribution [MWD], various methods ofdetermination of MWD.

KINETICS AND MECHANISM

Polymerization Kinetics Free radical polymerization, Mechanism of Polycondensation

POLYMERISATION

Techniques of Polymerization and nano composites: Techniques of polymerization, bulk,emulsion, suspension, Polymer composites and nano-composites

POLYMER PROCESSING

Methods of spinning for additive manufacturing: Wet spinning, Dry spinning. Biopolymers, Compatibility issues with polymers. Moulding and casting of polymers, Polymer processing techniques and the effect of these processing techniques on polymer structure,

DESIGN OF PLOYMERIC DEVICES

Designing of polymeric devices and polymers used for Additive: Aspects of designing polymeric devices and polymer additives, Polymers used for additive manufacturing : polyamide, PF resin, polyesters etc

Text Books

1	G Odian Principles of Polymerization, Wiley Inerscience Publisher John Wiley and Sons, 4th Edition, 2004.
2	V.R. Gowarikar Polymer Science, New Age International Publication 2019.

Reference Books

1	Fred.W. Billmeyer Jr Text book of Polymer Science, Wiley Inter science Publisher John Wiley and Sons, 3rd edition

Course Designers

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344213D06	3D PRINTING AND DESIGN	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble
The course is designed to impart knowledge and skills related to 3D printing Technologies.

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and procedure followed in 3D printing methods.
2	To construct a CAD model for a required product.
3	To identify the use of different material and support structures.
4	To experiment with different 3d printing process.
5	To identify the defects.

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

CO1.	Demonstrate the various 3D Printing methods	Understand
CO2.	Develop CAD Models, Import and Export CAD data and generate .STL file.	Apply
CO3.	Select a specific material for the given application.	Apply
CO4.	Select a 3D printing process for an application.	Apply
CO5.	Able to identify the Product defects after post processing	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	S	M	-	M	-	-	-	-	-	-	-	M	-	-
CO3	M	M	L	L	L	-	-	-	-	-	-	-	M	-	-
CO4	S	M	-	-	M	-	-	-	-	-	-	-	M	-	-
CO5	M	S	M	M	-	-	-	-	-	-	-	-	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

3D PRINTING & CAD FOR ADDITIVE MANUFACTURING

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications. CAD Data formats, Data translation, Data loss, STL format.

ADDITIVE MANUFACTURING TECHNIQUES

Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools

MATERIALS

Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.Support Materials

ADDITIVE MANUFACTURING EQUIPMENT

Process Equipment- Design and process parameters, Governing Bonding Mechanism
Common faults and troubleshooting, Process Design

POST PROCESSING & PRODUCT QUALITY

Post Processing Requirement and Techniques , Product Quality Inspection and testing , Defects and their causes

Text Books

1	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2	Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.

Reference Books

1	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
2	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3	J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.

Course Designers

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		Category	L	T	P	Credit
344213D07	**ADVANCED 3D PRINTING LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble
This course provides the basic knowledge about 3D printing .

Prerequisite – NIL

Course Objectives

1	To explain the basics of CAD modelling Techniques.
2	To construct the STL file for a given design.
3	Make use of software , to perform the simulation.
4	To demonstrate the orientation ,part slicing, supporting and tool path Generation.
5	To develop a working model using 3D printer.

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

CO1.	To demonstrate the working of 3D printer	Understand
CO2.	Construct a STL file for a given design	Apply
CO3.	Apply the software for performing the simulation	Apply
CO4.	Apply the concepts of orientation, part slicing, supporting and toolpath generation	Apply
CO5	Analyze the tool path simulation and generation of working models	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	L	L	-	-	-	-	-	-	-	-	L	M	-	S
CO2	M	M	M	-	-	-	-	-	M	-	-	M	L	-	M
CO3	S	M	M	-	-	-	-	-	S	-	-	M	M	-	S
CO4	L	M	L	-	-	-	-	-	M	-	-	M	S	-	S
CO5	L	S	L	-	S	-	-	-	M	-	-	S	S	-	M

S- Strong; M-Medium; L-Low

SYLLABUS:

LIST OF EXPERIMENTS:

1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups & Assigning Creative Idea
3. Generating STL files from the CAD Models & Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software
6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Simulation in Catalyst Software
8. Sending the tool path data to 3D Printer
9. Fabricating the physical part on 3D Printer
10. Removing the supports & post processing (cleaning the surfaces)
11. Demonstrating Creative Working Models
12. Converting CT/MRI scan data into STL file using MIMICS software (Demo)

Text Books

1	**3D Printing Lab manual**

Course Designers

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344213D08	**ADDITIVE MANUFACTURING MACHINES AND SYSTEMS**	**Category**	**L**	**T**	**P**	**Credit**
		EC-SE	**3**	**0**	**0**	**3**

Preamble

The course is designed to impart knowledge and discuss about the additiveManufacturing machines and systems.

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and techniques in Additive Manufacturing machines & Systems.
2	To develop various delivery system involved in AM machines and systems.
3	To identify the optical and optoelectronic components used in AM selection Process.
4	To identify various controllers used in AM machines and systems.
5	To discuss about the rapid tooling equipment systems.

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

CO1.	Demonstrate the various additive manufacturing machines and systems	Understand
CO2.	Apply the procedure involved in designing a delivery system in AM machines and system	Apply
CO3.	Apply optical and optoelectronic components in AM machines and systems	Apply
CO4.	Apply the various controllers in additive manufacturing machines and systems	Understand
CO5.	Able to construct the rapid tooling equipment	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	S	M	-	ML	-	-	-	-	-	-	-	L	-	-
CO3	M	M	-	-	L	-	-	-	-	-	-	-	M	-	-
CO4	L	M	-	-	L	-	-	-	-	-	-	-	M	-	-
CO5	M	S	M	L	-	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

CONSTRUCTION OF BASIC AM MACHINES

Construction of CNC Machine - Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors

ENERGY DELIVERY, MATERIAL DELIVERY, NOZZLE AND HEATING SYSTEMS

Lasers & electron beam, Laser scanning system and Fibre Delivery Systems, Powder feeding andWire feeding systems, Multi-material processing, Co-axial & Lateral Nozzles.

OPTICAL, OPTOELECTRONIC COMPONENTS

Laser, basic laser optics, collimators, beam expanders, optic fibres, metal optics etc.

CNC CONTROLLER & PROCESS CONTROLLER IN AM

CNC Controller, Process Controller – Process parameters, Scanning strategies – Raster scan, Patterned Vector Scanning and Hatching Patterns.

RAPID TOOLING EQUIPMENT & ENVIRONMENTAL CONTROL SYSTEMS

Introduction, Classification of Rapid Tooling, Direct and Indirect Methods, Applications Environmental controller for temperature, oxygen level, humidity etc.

Text Books

1	Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: 4th Edition of Rapid Prototyping.
2	Andreas Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, RapidTooling, Rapid Manufacturing, Hanser Publishers, Munich, Hanser Publications, Cincinnati.

Reference Books

1	Tooling: Technologies And Industrial Applications by Jacobs, Paul F.Jacobs, Kindle Edition
2	D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling.

Course Designers

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344213D09	PROTOTYPING METHODS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble : To study the Process involved and the methodology involved in building a Prototype.

Prerequisite : NIL

Course Objectives

1	To Understand the prototyping methodology using 3D Printer.
2	To know the product life cycle of the Prototype.
3	To Understand the Economic aspect of prototype.
4	To Understand the Functional aspect of prototype.
5	To Know the process flow and methods involved in development of prototype.

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

CO1.	To Understand the conversion of a CAD file format to a printable STL file format	Understand
CO2.	To understand the life cycle of a prototype and development based upon the application.	Analyze
CO3.	To develop an economic model or a prototype for testing.	Analyze
CO4.	To develop a functional model or a miniature based on the geometry or functionality.	Analyze
CO5.	To understand the various methods followed in developing a model	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	S	M	L		-	-	-	-	-	-	-	L	-	-L
CO3	M	L	L	-	M	-	-	-	-	-	-	-	L	-	-
CO4	M	L	S	M	S	-	-	-	-	-	-	-	M	-	-
CO5	M	M	M	S	M	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO PROTOTYPING

Introduction to Prototyping – Product development – Prototyping principles – Data processing functions – Engineering aspects & Tactics in prototyping – Data Dictionaries - Integrated software workbench tools

PROTOTYPE - LIFE CYCLE MANAGEMENT

Prototyping process – Product development - Types of Information system – Approaches to Systems Development – Business model - Technology model – Project management

ECONOMIC ASPECTS OF PROTOTYPE

Rapid manufacturing process optimization – Factors influencing accuracy – Errors in finishing - Training procedures – Tools & Techniques for prototype inspection – Robotic & computer aided simulation system

FUNCTIONAL ASPECTS OF PROTOTYPE

Factors favouring prototype - Assumptions in Prototype - Test plan - Operational documentation and procedures - Data size and operational impact analysis - Risk analysis.

PROTOTYPING METHODOLOGY

Classification of prototypes - Throw-away Prototyping - Evolutionary Prototyping - Low Fidelity Prototyping - High Fidelity Prototyping - Classification of user interface prototypes - Presentation Prototypes - Functional Prototypes – Breadboards - Pilot Systems.

Text Books

1	Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010

Reference Books

1	D.T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer, 2001

Course Designers

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344213D10	THEORY OF 3D PRINTING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

To study the various theories of 3D printing and the technologies used depending upon the application

Prerequisite :NIL

Course Objectives

1	Understand the fundamentals of various Additive Manufacturing Technologies.
2	To know about development of prototypes using liquid based 3D printing systems.
3	To know about development of prototypes using solid based 3D printing systems.
4	To know about development of prototypes using Powder based 3D printing systems.
5	To understand the recent trends in various industries.

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

CO1.	Understand the fundamentals of Additive Manufacturing Technologies for engineering applications.	Understand
CO2.	Understand the methodology to manufacture the products using SLA and SGC technologies	Understand
CO3.	Understand the methodology to manufacture the products using LOM and FDM technologies	Understand
CO4.	Understand the methodology to manufacture the products using SLS and 3D Printing technologies	Understand
CO5.	Understand the recent trends in 3D printing in various industries and its applications	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	-	S	-	-	-	-	-	-	-	-	L	-	-
CO2	M	L	L	L		-	-	-	-	-	-	-	M	-	M
CO3	M	M	L	-	S	-	-	-	-	-	-	-	L	-	L
CO4	S	M	L	M	S	-	-	-	-	-	-	-	S	-	-
CO5	S	M	S	S	M	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO ADDITIVE MANUFACTURING

Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields

LIQUID BASED SYSTEMS

Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working ,principle, applications, advantages and disadvantages, case studies.

SOLID BASED SYSTEMS

Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

POWDER BASED SYSTEMS

Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP):Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

RECENT TRENDS IN ADDITIVE MANUFACTURING

Scalability form Prototyping to Mass Production –Flexibility in multi jet printing – Multi material printing – Application of 3D Printing in Automotive, Medical, Aero space and Defence industries – Case studies

Text Books

1	Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996

Reference Books

1	Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Course Designers

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ELECTIVE COURSES SPECIALIZATION-AUTOMATED DESIGN AND MANUFACTURING ENGINEERING

34421AD01	**ADDITIVE MANUFACTURING PROCESSES AND APPLICATIONS**	**Category**	**L**	**T**	**P**	**Credit**
		EC-SE	**3**	**0**	**0**	**3**

Preamble

The course is designed to impart knowledge and discuss about the additive Manufacturing processes and applications.

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and techniques in Additive Manufacturing Processes
2	To develop a design for additive manufacturing processes
3	To identify the guidelines to be followed in AM selection Process
4	To identify various Additive manufacturing applications
5	To discuss about the post processing procedure in Additive Manufacturing Processes.

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

CO1.	Demonstrate the various additive manufacturing processes	Understand
CO2.	Apply the procedure involved in designing an additive manufacturing process	Apply
CO3.	Understand and apply the guidelines while selecting a AM process	Apply
CO4.	Understand the various application of additive manufacturing process	Understand
CO5.	Able to identify the post processing procedure in AM processes	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	L	-	-	-	-	-	-	-	-	-	-	M	-	M
CO2	S	S	M	-	M	-	-	-	-	-	-	-	S	-	M
CO3	M	M	-	-	L	L	-	-	-	-	-	-	L	-	L
CO4	M	S	-	-	L	-	-	-	-	-	-	-	M	-	L

CO5	S	L	M	M	-	-	-	-	-	-	-	-	M	-	ML

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO ADDITIVE MANUFACTURING

Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM,AM process chain - Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build, removal and clean up, post processing.

DESIGN FOR AM

Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

CLASSIFICATION OF AM PROCESSES & GUIDELINES FOR PROCESS SELECTION

Liquid polymer system, discrete particle system, molten material systems, solid sheet system, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control.

AM APPLICATIONS

Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and

POST PROCESSING OF AM PARTS

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Text Books

1	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
2	Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications",World Scientific, 2003.

Reference Books

1	Ali K. Kamrani, Emand Abouel Nasr, "Rapid Prototyping: Theory & Practice", Springer, 2006.
2	D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications ofRapid Prototyping and Rapid Tooling, Springer 2001

Course Designers

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		Category	L	T	P	Credit
34421AD02	**MECHANICAL DESIGN**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

To introduce the concepts of Mechanical design process in finding a solution for an engineering problem

Prerequisite - NIL

Course Objectives

1	To discuss the basic concepts of mechanical design
2	To apply the concepts of engineering design
3	To identify the steps involved in product planning and development
4	To make use of the conceptual design concepts in finding solution for a problem
5	To apply embodiment design concepts effectively

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

CO1.	Discuss the basic concepts involved in Mechanical Design	Understand
CO2.	Demonstrate the fundamentals of engineering design and technical systems	Apply
CO3.	Illustrate the steps involved in product planning and development	Apply
CO4.	Demonstrate the conceptual design for a engineering problem	Apply
CO5.	Illustrate the Embodiment design	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	M	M	M	-	-	-	-	-	-	-	-	-	M	-	M
CO2	M	S	S	-	-	-	-	-	-	-	-	-	S	-	L
CO3	L	L	L	L	-	L	-	-	-	-	-	-	L	-	L
CO4	M	M	L	L	-	M	-	-	-	-	-	-	L	-	L

CO5	L	M	L	M	M	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

ENGINEERING DESIGN

Steps in designing, tasks and activities, varieties of engineering, design process and role of designer, iteration, decision making, resource conversion, systems and devices and variety of needs, need analysis, feasibility study, preliminary design, detail design, revision. Information for need and problems associated with information, variety of information.

FUNDAMENTALS OF TECHNICAL SYSTEMS

System approach fundamentals, assemblies and components, interrelationships, creativity as means to synthesis of alternatives, estimating the order of magnitude, design records.

PRODUCT PLANNING AND DEVELOPMENT

Life cycle from production to consumption and disposal, description of tasks, description of design specification and activities.

CONCEPTUAL DESIGN

Abstraction, modelling of an engineering problem; iconic, analog and symbolic models; determination of dimensions, graphics, visualization and synthesis, characteristics of a good model, value system and criterion function.

EMBODIMENT DESIGN

Steps, rules and principles, mechanical connections, modular products, design for quality and cost. Optimization, optimum vs. optimal. Optimum and robust design. Communication and reporting, preparing and presenting the report, oral vs. written communication, aids.

Text Books

1	Mechanical Design Process by DJ Ullman; McGraw-Hill Book Co..
2	Introduction to Engineering Design by T T Woodson; McGraw-Hill Book Co., Kogakusha Co. Ltd.

Reference Books

1	Engineering Design by GE Dieter; McGraw-Hill Book Co.
2	Conceptual Design for Engineers by Michael French; Springer
3	The Principles of Design by NP Suh; Oxford

Course Designers

S.No.	**Faculty Name**	**Designation**	**Department/Name of the**	**Email id**

1	Dr.L.Prabhu	Assoc.Professor	Mech/AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD03	**INTEGRATED PRODUCT DESIGN AND DEVELOPMENT**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

The course is designed to impart knowledge about the procedure and designcriteria followed while developing a product

Prerequisite – Nil

Course Objectives

1	To discuss the basic concepts and techniques in Additive Manufacturing Processes
2	To develop a design for additive manufacturing processes
3	To identify the guidelines to be followed in AM selection Process
4	To identify various Additive manufacturing applications
5	To discuss about the post processing procedure in Additive Manufacturing Processes.

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

CO1.	Demonstrate the various additive manufacturing processes	Understand
CO2.	Apply the procedure involved in designing an additive manufacturing process	Apply
CO3.	Understand and apply the guidelines while selecting a AM process	Apply
CO4.	Understand the various application of additive manufacturing process	Understand
CO5.	Able to identify the post processing procedure in AM processes	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	M	L	-	-	-	-	-	-	-	-	-	-	M	-	M
CO 2	S	S	M	-	L	-	-	-	-	-	-	-	L	-	L
CO 3	M	M	-	-	M	-	-	-	-	-	-	-	L	-	M

CO 4	M	M	-	-	L	-	-	-	-	-	-	-	L	-	L
CO 5	M	L	M	M	-	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

MODERN PRODUCT DEVELOPMENT, PROCESS TOOLS AND DESIGN THEORIES

Understanding the opportunity, Develop a concept, Implement a concept, Reverse engineering and redesign methodology, Product development teams, Planning Process, Planning and scheduling tools.

UNDERSTANDING CUSTOMER NEEDS & ESTABLISHING PRODUCT FUNCTION

Kano diagram of customer satisfaction, Prioritising Customer needs, Function analysis system technique, Function structure. Product tear down and experimentation: Tear down process, methods, applications, Post teardown reporting. Benchmarking and establishing engineering specifications

PRODUCT PORTFOLIOS AND PORTFOLIO ARCHITECTURE, GENERATING CONCEPTS AND CONCEPT SELECTION

Portfolio architecture types and choice, Product modularity, Clustering, Information gathering, Brainstorming, TRIZ, Morphological Evaluation, Concept selection Process, Numerical Concept scoring.

CONCEPT EMBODIMENT, MODELLING OF PRODUCT METRICS

System modelling and embodiment principles, Modelling approaches and case studies. Design for the environment: DFE methods, Life cycle assessment, Techniques to reduce environmental impact.

ANALYTICAL AND NUMERICAL MODEL SOLUTIONS

Simulation and optimization techniques, Design for robustness: Robust Design model construction, methods

Text Books

1	Kevin N. Otto, Kristin L. Wood, Product Design, Pearson Education, 2004.
2	W. Ernest Eder, S. Hosendl., Design Engineering, CRC Press, 2008.

Reference Books

1	Gahl, W Beitz J Feldhusun, K. G. Grote, Engineering Design, 3rd Edition, Springer 2007.
2	Ali K. Kamrani and Emad Abouel Nasr, "Engineering Design and Rapid Prototyping", Springer, 2010.

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ Name of the College**	**Email id**

1	Dr.L.Prabhu	Assoc.Professor	Mech/AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD04	**MANUFACTURING CONTROL AND AUTOMATION**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

The course is designed to impart skill and knowledge manufacturing control and automation.

Prerequisite – Nil

Course Objectives

1	Understand the fundamentals of automation, when and where to apply them.
2	Identify various material handling systems and automation systems.
3	Apply various control systems in manufacturing and evaluate automatic production
4	Design an optimal circuit for automation.
5	Use modeling and simulation for manufacturing automation.

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

CO1.	Understand the fundamentals of automation, when and where to apply them.	Understand
CO2.	Identify various material handling systems and automation systems.	Apply
CO3.	Apply various control systems in manufacturing and evaluate automatic production	Apply
CO4.	Apply an optimal circuit for automation.	Apply
CO5.	Use modeling and simulation for manufacturing automation.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	M	M	-	-	-	-	-	-	-	-	-	-	L	-	M
CO 2	S	L	M	-	L	-	-	-	-	-	-	-	M	-	L
CO 3	L	L	-	-	L	L	-	-	-	-	-	-	-	-	L
CO 4	S	M	-	-	L	-	-	-	-	-	-	-	M	-	L

CO 5	L	S	L	L	-	-	-	-	-	-	-	-	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Automation in production system principles and strategies of automation, basic Elements of a automated system. Advanced Automation functions. Levels of Automations, introduction to automation productivity.

MATERIAL HANDLING SYSTEM & AUTOMATED MANUFACTURING SYSTEMS

Over view of Handling system-Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Transport system storage system, Components of automation, line balancing, manufacturing cells & transfer mechanism. Fundamentals and analysis of transfer lines product design for automatic assembly.

CONTROL TECHNOLOGIES IN AUTOMATION

Industrial control system. Process industry vs Discrete manufacturing industries. Continuous vs discrete control. Continuous process and its forms, Sensors and Actuators. Other control system components. Supervisory Production Control and Management Systems, Evaluation of Automatic Production Product manufacturability. Orientation devices- active and passive devices, Parts orientation and Escapement.

PNEUMATIC AND HYDRAULIC COMPONENTS AND CIRCUITS

Pneumatic sensors and amplifiers. Jet destruction devices, Logic devices, Schmit triggeringdevices, developing pneumatic circuits for automatic die casting machine.

MODELING AND SIMULATION FOR MANUFACTURING PLANT AUTOMATION

Introduction. Need for system modeling. Building mathematical model of a manufacturingplant. Modern tools in manufacturing automation, Robots and Application of Robots for

Text Books

1	Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Prentice Hall Inc., New Delhi, 2007.
2	Tiess Chiu Chang and Richard A.W., An Introduction to Automated Process Planning Systems, TMH, New Delhi, 2000.

Reference Books

1	Nanua Singh, System Approach to Computer Integrated Manufacturing, Wiley & Sons Inc., 1996.
2	Andrew Kusiak, Intelligent Manufacturing System, Prentice Hall Inc., New Jersey, 1992.

Course Designers

S.No	Faculty Name	Designation	Department/Name of the College	Email id
1	Dr.L.Prabhu	Assoc.Professor	Mech/AVIT	prabhu@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD05	**ADVANCED MACHINING PROCESSES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

To impart knowledge on the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.

Prerequisite – Nil

Course Objectives

1	To learn about the fundamental as well as advanced knowledge of Micro Nano machining Technology.
2	To explain the basic principles and mechanism of Traditional Micro Nano machining and its applications.
3	To illustrate the basic principles and applications of Advanced Micro Nano Machining.
4	To demonstrate the basic principles and applications of different Abrasive based Micro Nano Machining.
5	To illustrate the fundaments of MEMS and its techniques.

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

CO1.	Explain the basic need of Micro Nano Machining in different industries	Understand
CO2.	Summarize the traditional Micro Nano Machining techniques.	Understand
CO3.	Demonstrate and Understand different mechanisms in Advanced Micro Nano Machining.	Understand
CO4.	Utilize the importance of Abrasives in Micro Nano Machining.	Apply
CO5.	Identify the need of MEMS in Micro Nano Machining.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	L	-	-	-	-	-	-	-	-	-	-	S	-	-
CO2	L	-	-	-	-	-	-	-	-	-	-	S	-	-
CO3	M	L	-	-	-	-	-	-	-	-	-	S	-	-
CO4	M	L	-	-	-	-	-	-	-	-	-	S	-	-
CO5	M	L	-	-	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Types of advanced manufacturing processes; Evolution, need, and classification of advanced machining processes.

MECHANICAL PROCESSES

USM, Rotary Ultra Sonic Machining (RUM), AJM, WJM, AWJM processes - Process principle and mechanism of material removal; Process Parameters; Process Capabilities; Applications; Operational characteristics; Limitations.

ADVANCED FINE FINISHING PROCESSES

Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto Rheological Abrasive Finishing (MRAF) - Process principle; Process equipment; Process Parameters; Process Capabilities; Applications; Limitations.

CHEMICAL & ELECTRO CHEMICAL PROCESSES

Process principle and details of Chemical Machining (CHM), Photo- Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes. ECM - Process principle; Mechanism of material removal; Process Parameters; Process Capabilities; Applications, Tool Design, Electro Chemical Deburring (ECDE).

THERMAL PROCESSES

EDM, Wire Electro Discharge Machining (WEDM), LBM, EBM, IBM, PAM processes – Process principle and mechanism of material removal; Process parameters and characteristics; Surface finish and accuracy, Process Capabilities; Applications; Limitations.

Text Books

1	V. K. Jain, Advanced Machining Processes, 1st edition, Allied Publishers Pvt. Ltd, 2007. ISBN: 978-8177642940.

Reference Books

1	H. Abdel and G. El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, 1st edition, McGraw-Hill Professional, 2005. ISBN: 978- 0071453349.
2	G.F. Benedict, Nontraditional Machining Processes, 1st edition, Marcel Dekker Inc., 2002.

Course Designers

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1	B.Selva Babu	Assistant Professor	Mech / AVIT	selvababu@avit.ac.in
2	M.Saravanan	Associate Professor	Mech/VMKVEC	saravanan@vmkvec.edu.in

34421AD06	ROBOTICS BASED INDUSTRIAL AUTOMATION	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE

To introduce the concepts of automation in Various Industrial applications

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To understand robotics based industrial automation
2	To Identify the various automated assembly systems
3	To develop automated material handling and storage system
4	To identify the various automated inspection and testing methods.
5	To build the automated manufacturing systems.

COURSE OUTCOMES

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

CO1.	Understand the basics of Industrial Automation	Understand
CO2.	Construct various automated assembly systems	Apply
CO3.	Construct the automated material and storage systems.	Apply
CO4.	Demonstrate automated inspection and Testing methods	Apply
CO5.	Construct the automated manufacturing systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO2	PSO3
CO1	M	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	L	S	M	-	M	-	-	-	-	-	-	-	S	-	-
CO3	M	M	M	L	M	-	-	-	-	-	-	-	S	-	-
CO4	S	M	M	L	M	M	-	-	-	-	-	-	S	-	-
CO5	S	S	M	L	M	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION & FIXED AUTOMATION

Definition, automation principles and strategies, scope of automation, low cost automation Production concepts and automation strategies. Automated Flow lines, Methods of Work part Transport, Transfer Mechanism - Continuous transfer, intermittent transfer, and Indexing mechanism, Buffer Storage, Control Functions and Automation for Machining Operations. Analysis of Transfer Lines without Storage, Partial Automation, Automated Flow Lines with Storage Buffers.

AUTOMATED ASSEMBLY SYSTEMS

Design for Automated Assembly, Types of Automated Assembly Systems, Vibratory bowl feeder and Non vibratory bowl feeder, Part Orienting Systems, Feed tracks, Escapements and part placing mechanism, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine.

AUTOMATED MATERIAL HANDLING & STORAGE SYSTEM

The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Storage System Performance, Automated Storage/Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing.

AUTOMATED INSPECTION AND TESTING

Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods.

MODELING OF AUTOMATED MANUFACTURING SYSTEMS

Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models.

TEXT BOOKS:

1	Mikell P.Grover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia, 2001.
2	C.RayAsfahl, "Robots and manufacturing Automation", John Wiley and Sons New York, 1992.

REFERENCES:

1	N.Viswanadham and Y.Narahari, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Pvt. Ltd, 1992.
2	Stephen J. Derby, "Design of Automatic Machinery", Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai, 2004.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department /Name of the College	Mail ID
1	R.Praveen	Assistant Professor G-II	Mech/AVIT	praveen@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

34421AD07	AUTOMATION IN MANUFACTURING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

PREAMBLE : To introduce the concepts of automation in Various Industrial applications

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand robotics based industrial automation
2	To Identify the various automated assembly systems
3	To develop automated material handling and storage system
4	To identify the various automated inspection and testing methods.
5	To build the automated manufacturing systems.

COURSE OUTCOMES

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

CO1.	Understand the basics of Industrial Automation	Understand
CO2.	Construct various automated assembly systems	Apply
CO3.	Construct the automated material and storage systems.	Apply
CO4.	Demonstrate automated inspection and Testing methods	Apply
CO5.	Construct the automated manufacturing systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	S	M	-	L	-	-	-	-	-	-	-	L	-	L

CO 3	M	M	L	L	L	-	-	-	-	-	-	-	M	-	L
CO 4	L	L	M	L	M	S	-	-	-	-	-	-	M	-	-
CO 5	S	M	M	L	L	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

MECHATRONIC SYSTEMS

Overview of mechatronic systems and devices in manufacturing, automated feeding, transfer, retrieval mechanisms and devices, AGVs, FMS workstations, material handling and storage systems, overview of sensors, transducers and control systems in manufacturing.

HYDRAULIC SYSTEMS

Hydraulic systems: flow, pressure and direction control valves, actuators, supporting and control elements, pumps, servo valves and actuators, electro hydraulic servo- valves, proportional valves and their applications, design of hydraulic circuits for mfg applications and performance analysis.

PNEUMATIC SYSTEMS

Production, distribution and conditioning of compressed air, system components and graphic representations, design of circuits-switching circuits and sequential circuits, cascade methods, step counter method, compound circuit design.

ROBOTICS IN AUTOMATION

Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing.

PLCS AND MICROPROCESSORS

Basic structure - Input / Output processing - Programming - Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC, Programming and interfacing of microprocessors in manufacturing applications.

TEXT BOOKS:

1	Mikell P.Grover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education Asia, 2001.
2	C.RayAsfahl, "Robots and manufacturing Automation", John Wiley and Sons New York, 1992.

REFERENCES:

1	N.Viswanadham and Y.Narahari, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Pvt. Ltd, 1992.
2	Stephen J. Derby, "Design of Automatic Machinery", Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai, 2004.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	R.Praveen	Assistant Professor G-II	Mech/AVIT	praveen@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD08	**ADVANCED CIM LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble: This course provides the basic knowledge about computer Integrated Manufacturing

Prerequisite – NIL

Course Objectives

1	To explain the basics of components required for building a CIM.
2	To construct the CNC program for a given profile in milling & Turning.
3	Make use of various features and commands in modelling software in designing a product

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

CO1.	Apply the knowledge of sensors, transducers and other components in building a CIM system	Apply
CO2.	Apply the knowledge of mirroring, canned cycle and subroutine concepts to write the CNC program	Apply
CO3	Develop a part model using various commands	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M	L	L	-	-	-	-	-	-	-	-	L	M	-	L
CO2	M	S	M	-	-	-	-	-	M	-	-	M	M	-	M
CO3	L	L	M	-	-	-	-	-	L	-	-	M	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS:

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
3. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.
4. Mini project on any one of the CIM elements is to be done. This can be either a software or hardware simulating a CIM element. At the end of the semester, the students have to submit a mini report and present his work before a Committee.

CAD LABORATORY

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

Text Books

1	**CIM LAB Manual**

Course Designers

S.No	Faculty Name	Designation	Department/ College	Email id
1	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in
2	R.Praveen	Asst.Professor G-II	Mech/ AVIT	praveen@avit.ac.in

	PRODUCT DESIGN FOR MANUFACTURING AND ASSEMBLY	**Category**	**L**	**T**	**P**	**Credit**
34421AD09		**EC-SE**	**3**	**0**	**0**	**3**

PREAMBLE: To introduce the concepts of automation in Various Industrial applications

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand robotics based industrial automation
2	To Identify the various automated assembly systems
3	To develop automated material handling and storage system
4	To identify the various automated inspection and testing methods.
5	To build the automated manufacturing systems.

COURSE OUTCOMES

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

CO1.	Understand the quality aspects of design for manufacture and assembly.	Understand
CO2.	Apply Boothroyd method of DFM for product design and assembly.	Apply
CO3.	Apply the concept of DFM for casting, welding, forming and assembly.	Apply
CO4.	Identify the design factors and processes as per customer specifications.	Apply
CO5.	Apply the DFM method for a given product.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	-	-	S	-	-	-	-	-	-	-	M	-	-

CO2	M	S	M	-	M	-	-	-	-	-	-	-	L	-	L
CO3	S	S	M	L	M	-	-	-	-	-	-	-	M	-	M
CO4	M	M	M	L	L	M	-	-	-	-	-	-	M	-	M
CO5	S	M	L	L	L	-	-	-	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO DFM, DFMA

How Does DFMA Work?, Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

HIGH SPEED AUTOMATIC ASSEMBLY & ROBOT ASSEMBLY

Design of Parts for High-Speed Feeding and Orienting, Additional Feeding Difficulties, High-Speed Automatic Insertion, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly.

DESIGN FOR MACHINING AND INJECTION MOLDING

Machining Using Single-Point & Multi point cutting tools, Choice of Work Material, Shape of Work Material, Machining Basic Component Shapes, Cost Estimating for Machined Components, Injection Molding Materials, The Molding Cycle, Injection Molding Systems, Molding Machine Size, Molding Cycle Time, Estimation of the Optimum Number of Cavities, Design Guidelines.

DESIGN FOR SHEET METAL WORKING & DIE CASTING

Dedicated Dies and Press-working, Press Selection, Turret Press working, Press Brake Operations, Design Rules, The Die Casting Cycle, Auxiliary Equipment for Automation, Determination of the Optimum Number of Cavities, Determination of Appropriate Machine Size, Die Casting Cycle Time Estimation, Die Cost Estimation, Design Principles.

DESIGN FOR ASSEMBLY AUTOMATION

Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated *as*sembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

TEXT BOOKS:

1	Geoffrey Boothroyd, Assembly Automation and Product Design, Marcel Dekker Inc., NY, 3rd Edition,2010.
2	Geoffrey Boothroyd, Hand Book of Product Design, Marcel Dekker Inc., NY, 1992.

REFERENCES:

1	GeofferyBoothroyd, Peter Dewhurst and Winston Knight,A, "Product Design for Manufacture and Assembly", CRC Press, 2011.

2	KarlUlrich,T, Steven Eppinger, D, "Product Design and Development", McGrawHill, 2015.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department / Name of the College	Mail ID
1	R.Praveen	Assistant Professor G-II	Mechanical, AVIT	praveen@avit.ac.in
2	Dr. N.Rajan	Professor	Mech / VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD10	**REVERSE ENGINEERING AND COMPUTER AIDED INSPECTION**	**EC-SE**	**3**	**0**	**0**	**3**

PREAMBLE : To introduce the concepts of automation in Various Industrial applications

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand robotics based industrial automation
2	To Identify the various automated assembly systems
3	To develop automated material handling and storage system
4	To identify the various automated inspection and testing methods.
5	To build the automated manufacturing systems.

COURSE OUTCOMES

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

CO1.	Identify and explain the steps involved in reverse engineering of a given component.	Understand
CO2.	Develop design changes satisfying client's requirements and fabricate a given component bypassing the regular design and manufacturing steps.	Apply
CO3.	Apply the concepts of calibration, traceability and uncertainty for accurate and reliable measurements.	Apply
CO4.	Identify and estimate measurement errors and suggest suitable techniques to minimize them.	Apply
CO5.	Describe the methods and devices for dimensional metrology.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO2	PSO3

	1														
CO1	S	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO2	S	S	M	-	M	-	-	-	-	-	-	-	S	-	-
CO3	S	S	M	L	M	-	-	-	-	-	-	-	S	-	-
CO4	S	S	S	L	M	M	-	-	-	-	-	-	S	-	-
CO5	S	S	M	L	M	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

METHODOLOGIES AND TECHNIQUES FOR REVERSE ENGINEERING

Introduction to reverse engineering, Reverse Engineering–The Generic Process
The Potential for Automation with 3-D Laser Scanners, What Is Not Reverse Engineering, What is Computer-aided (Forward) Engineering, What Is Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering Reverse Engineering–Hardware and Software: Contact Methods Noncontact Methods, Destructive Method

SELECTING A REVERSE ENGINEERING SYSTEM

The Selection Process, Some Additional Complexities, Point Capture Devices, Triangulation Approaches, "Time-of-flight" or Ranging Systems, Structured-light and Stereoscopic Imaging Systems, issues with Light-based Approaches, Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive Systems, Some Comments on Accuracy, Positioning the Probe, Post processing the Captured Data, Handling Data Points, Curve and Surface Creation, Inspection Applications, Manufacturing Approaches

INTEGRATION BETWEEN REVERSE ENGINEERING AND ADDITIVE MANUFACTURING

Modeling Cloud Data in Reverse Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer-based Model Generation, he Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness

MEASUREMENT TECHNIQUES

Surface Roughness Measurement: Components of surface texture, Need for surface roughness measurement, Measurement of surface roughness, Roughness characterization, Roughness grades Geometric Form Measurement: Importance, Indication, Intrinsic and Extrinsic methods, Roundness, Straightness, Flatness, Cylindricity, Squareness, Parallelism, Run out and concentricity Coordinate Measuring Machine - Types of CMM - Probes used – Applications - dimensional metrology – Non-contact sensors for surface finish measurements. Screw Thread

Measurement: Terminology, Forms of thread, Errors in threads, Measurement of major, minor and effective diameters	
OTHER COMPUTER AIDED INSPECTION TECHNIQUES/INSTRUMENTS	
In-process Inspection and On- line Sensing, Automated Inspection Techniques, Imageprocessing and its application in Metrology.	
TEXT BOOKS:	
1	K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and NewProduct Development, Prentice Hall, 2001.
2	Reverse Engineering: An Industrial Perspective by Raja and Fernandes, Springer-Verlag 2008.
REFERENCES:	
1	Thomas. G. G., Engineering Metrology, Butterworth Pub.1974.
2	R. K. Jain, Engineering Metrology, Khanna Publishers, 19/e, 2005.

COURSE DESIGNERS

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2	Dr. N.Rajan	Professor	MECH/VMKVEC	rajan@vmkvec.edu.in

		Category	L	T	P	Credit
34421AD11	**AUTOMATION LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

To train the students in hydraulic and pneumatic circuit design using different control devices

Prerequisite

NIL

Course Objectives

1	Design Hydraulic and Pneumatic circuits for low cost automation
2	To understand the working of logical circuits
3	To understand the operation of basic electro pneumatic circuits
4	To design open loop and closed loop control circuit of AC servo motor
5	Application of PLC to design a system.

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

CO1.	Understand principles, strategies and advantages of industrial Automation	Understand
CO2.	Design material handling and material storage systems for an automated factory	Understand
CO3.	Devise automated shop floor controls and part identification methods	Understand
CO4.	Outline the IoT Technologies used in a manufacturing plant and their role in Industry	Understand
CO5.	Understand the basics of vehicle collision and its effects.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	-	M	-	-	-	-	-	-	L	-	-
CO2	S	S	S	S	M	S	-	-	-	S	-	-	L	-	-
CO3	S	M	L	-	-	L	-	-	-	-	-	-	L	-	-
CO4	S	M	L	-	L	L	-	-	-	-	-	-	L	-	-
CO5	S	S	M	L	-	M	-	-	-	-	-	L	L	-	-

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. To design a Speed control circuits for double acting cylinder.
2. To design a Synchronization circuit for two cylinders.
3. To design a Continuous reciprocation of double acting cylinder.
4. To design a Sequencing of two cylinder circuits.
5. To design a Cascading circuit for trapped signals-2 groups
6. Implementation of Logic Circuits: AND,OR
7. Design of Basic Electro Pneumatic Circuits: Continuous reciprocation of cylinder (with timer and counter)
8. Design and testing of Force, Velocity calculations in Hydraulic Linear actuation
9. Automatic bottle filling Machine
10. Design and simulation of PLC Control Pneumatic/ Hydraulic linear actuator circuits.
11. To design a Water Level Controller using PLC.
12. To design a PLC Controlled Material Handling System.

Text Books

1	**AUTOMATION LAB Manual**

Course Designers

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1	M.Saravanan	Asst.Prof	MECH/ AVIT	saravanan@avit.ac.in
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ELECTIVE COURSES SPECIALIZATION-AUTOMOBILE ENGINEERING

		Category	L	T	P	Credit
34421AU01	**AUTOMOTIVE CHASSIS LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

To impart knowledge in the assembling and dismantling of different types of systems like steering system, transmission system and braking system.

Prerequisite

Nil

Course Objectives

To employ the knowledge and measurement of light and heavy commercial Vehicle chassis
To demonstrate the knowledge to dismantling, study and Assembling of front and rear axle .
To demonstrate the knowledge to dismantling, study and Assembling of Clutch, Gearbox, Steering gearbox, Breaking and Differential systems

Course Outcomes

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

CO1. Conduct measurement of light and heavy commercial Vehicle chassis	Apply
CO2. Develop Thoroughly develop knowledge of dismantling, study and Assembling of front and rear axle.	Apply
CO3. Develop the knowledge in dismantling, study and Assembling of clutch, gearbox, steering gearbox, breaking and differential systems	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-
CO2	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-
CO3	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Study and measurement of Light commercial vehicle chassis layout
2. Study and measurement of Heavy commercial vehicle chassis layout
3. Dismantling, study and Assembling of Front Axle Systems.
4. Dismantling, study and Assembling of Rear Axle Systems
5. Dismantling, study and Assembling of steering systems with different Steering gearboxes
6. Dismantling, study and Assembling of Clutch.
7. Dismantling, study and Assembling of Gear box with different gear box
8. Dismantling, study and Assembling of Differential.
9. Dismantling, study and Assembling of Braking system.
10. Dismantling, study and Assembling of different types of suspension system.

Text Books

1. **'**Automotive Chassis Lab Manual', Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission's Research Foundation (Deemed to be University), Salem.

Course Designers:

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2	M.Saravana Kumar	Assistant. Professor GRII	Mech / AVIT	saravanakumar@avit.ac.in
3	N. Shivakumar	Assistant. Professor GRII	Mech / AVIT	shivakumar@avit.ac.in

		Category	L	T	P	Credit
34421AU02	AUTOMOTIVE CHASSIS	EC-SE	3	0	0	3

Preamble

A chassis is the internal framework of an artificial object, which supports the object in its construction and use. An example of a chassis is a vehicle frame, the under part of a motor vehicle, on which the body is mounted; if the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.

Prerequisite

Nil

Course Objectives

1. To apply the concept of entire process involved in vehicle frame and steering systems.
2. To perform the application of propeller shaft and final drive
3. To employ the concepts of axles and tyres.
4. To perform the application of Suspension System.
5. To apply the concepts of braking system in automotive chassis

Course Outcomes

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

CO1. Summarize Automotive chassis and its accessories.	Understand
CO2. Utilize the applications of final drive	Apply
CO3. Apply the knowledge of axles and tyres.	Apply
CO4. Utilize the applications of Suspension System.	Apply
CO5. Develop the concepts of braking System.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	-	-	-	-	-	-	-	M	L	-	-
CO2	S	M	M	M	-	-	-	-	-	-	-	M	L	-	-
CO3	S	M	M	M	-	-	-	-	-	-	-	M	L	-	-
CO4	S	M	M	M	-	-	-	-	-	-	-	M	L	-	-
CO5	S	M	M	M	-	-	-	-	-	-	-	M	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION, FRAME, STEERING SYSTEM

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, Types of Front Axles and Stub Axles, Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

PROPELLER SHAFT AND FINAL DRIVE

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction and twin speed final drives, Multi–axled vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler Tractors.

AXLES AND TYRES

Construction and Design of Drive Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tyres and their constructional details.

SUSPENSION SYSTEM

Need for Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details, Design of Leaf and Coil Springs.

BRAKING SYSTEM

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Hydraulic, Mechanical, Pneumatic and Power–Assisted Braking System, Servo Brakes, Retarders, Anti–Lock Braking System.

TEXT BOOK:

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2012.
2. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited, 2015.
3. N.K. Giri, Automotive Mechanics, Kanna Publishers, 2007.

REFERENCES:

1. Heldt P.M., Automotive Chassis, Chilton Co., New York, 1990
2. Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3. Heinz Hezler, Modern Vehicle Technology, Butterworth, London, 2005.

Course Designers:

S.No	Name of the Faculty	Designation	Department/College	Mail ID
1	T.Raja	Associate Professor	Mech / VMKVEC	rajat@vmkvec.edu.in
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34421AU03	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS LAB**	**Category**	**L**	**T**	**P**	**Credit**
		EC -SE	**0**	**0**	**4**	**2**

Preamble

To familiarize and train the students on the constructional arrangements of different electrical system of automobiles and study the automobile electronics components.

Prerequisite

Nil

Course Objectives

1.	To perform in battery tests, charging system and starting system trouble shooting.
2.	To demonstrate the application knowledge in the operation of alternator and lighting system.
3.	To describe the temperature and optical sensor.

Course Outcomes

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

CO1.Experiment with the battery, charging system and starting system.	Apply
CO2. Develop thoroughly develop knowledge in application of operation of alternator and lighting system.	Apply
CO3. Make use of temperature and optical sensor	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-
CO2	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-
CO3	S	S	S	S	M	M	M	-	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Testing, charging and discharging of lead acid battery used in automobiles.
2. Testing and troubleshooting of starting system in automobiles.
3. Starter motor component test.
4. Testing and troubleshooting of charging system in automobiles.
5. Alternator component test.
6. Testing and troubleshooting of lighting system in automobiles.
7. Testing of lighting conventional analog instrumentation, indicator light, warning devices.
8. Study of Temperature measurement using thermocouple.
9. Study of optical sensor

Text Books

1. **‘**Automotive Electrical and Electronics Lab Manual’, Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission’s Research Foundation (Deemed to be University), Salem

Course Designers:

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1	T.Raja	Associate Professor	Mech / VMKVEC	rajat@vmkvec.edu.in
2	M.Saravana Kumar	Assistant. Professor GRII	Mech / AVIT	saravanakumar@avit.ac.in
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34421AU04	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	Category	L	T	P	Credit
		EC -SE	3	0	0	3

Preamble

Automotive electrical and electronic systems used in road vehicles, enable study analyze and apply the concepts of various electrical and electronics component such as battery alternator ignition system and other engine management systems.

Prerequisite

Nil

Course Objectives

1. To perform the concepts of battery and charging systems..
2. To compile the knowledge of starting systems in the vehicle.
3. To employ the knowledge in the application of various types of charging system & lighting system.
4. To demonstrate the application and knowledge of fundamental of automotive electronics.
5. To employ the application and knowledge of sensors and actuators.

Course Outcomes

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

CO1. Outline the concepts of Electrical and Electronics System	Understand
CO2. Summarize the various concept of starting systems.	Understand
CO3. Apply the various types of charging system & lighting system.	Apply
CO4. Identify the application automotive electronics.	Apply
CO5. Compare the sensors and actuators.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	-	-	-	-	-	-	-	L	L	-	-
CO2	S	M	M	L	-	-	-	-	-	-	-	L	L	-	-
CO3	S	S	S	M	-	-	-	-	-	-	-	M	L	-	-
CO4	S	S	S	M	-	-	-	-	-	-	-	M	L	-	-
CO5	S	S	S	M	-	-	-	-	-	-	-	M	L	-	-

S- Strong; M-Medium; L-Low

Syllabus

BATTERIES

Principle and construction of lead-acid battery. Characteristics of battery, rating, capacity and efficiency of batteries. Various tests on battery condition, charging methods. Details of modern storage batteries.

STARTING SYSTEM

Condition of starting Behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Working of different starter drive units. Care & maintenance of starter motor, Starter switches.

CHARGING SYSTEM & LIGHTING SYSTEM

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensatedvoltage regulator, alternators principle and constructional aspects and bridgerectifiers, new developments. Lighting system: insulated and earth return system, details of head light and sidelight, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

SENSORS AND ACTUATORS

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature,air mass flow for engine application. Solenoids, stepper motors, relay.

TEXT BOOK:

1. Kholi,P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd., New Delhi, 2004.
2. Judge,A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 2004.
3. Younng A.P & Griffiths L, "Automobile Electrical and Electronic Equipments", English Languages Book Society & New Press.
4. Tom Weather Jr and Cland C.Hunter, "Automotive Computers and Control system", Prentice Hall Inc., New Jersey.

REFERENCES:

1. Vinal,G.W., Storage Batteries, John Wiley & Sons Inc., New York, 1985.
2. Crouse,W.H., Automobile Electrical Equipment, McGraw Hill Book Co. Inc., New York, 1980.
3. Spreadbury,F.G., Electrical Ignition Equipment, Constable & Co. Ltd., London, 1962.
4. Automotive Hand Book, fifth edition, Robert Bosch, Bently Publishers, 2003.

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		Category	L	T	P	Credit
34421AU05	AUTOMOTIVE POLLUTION CONTROL	EC-SE	3	0	0	3

Preamble

To study and purpose is to understand automotive pollution control.

Prerequisite

NIL

Course Objectives

1	To understand the introduction of pollutions.
2	To understand the pollution formation in SI engines.
3	To understand the pollution formation in CI engines
4	To impart the control of emission in CI engines.
5	To understand the measurement technique and emission standards.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Summarize the current scenario of Automobile Emissions and standards	Understand
CO2.	Apply the formation of Emissions from SI Engines.	Apply
CO3.	Apply the formation of Emissions from CI Engines.	Apply
CO4.	Examine Emission and control Techniques in SI and CI Engines.	Analyze
CO5.	Inspect measuring techniques of Emission and test procedure	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	--	--	--	--	M	M	--	--
CO2	S	S	S	S	M	--	--	--	--	--	--	M	M	--	--
CO3	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--
CO4	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--
CO5	S	S	S	S	M	--	--	--	--	--	--	S	M	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION
Introduction pollution control act- norms and standards. Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, types of emission, transient operational effects on pollution
POLLUTANT FORMATION IN SI ENGINES
Pollutant formation in SI Engines, mechanism of HC and CO formation in four stroke and two stroke SI engines, NOx formation in SI engines, effects of design and operating variables on emission formation, control of evaporative emission. Two stroke engine pollution
POLLUTANT FORMATION IN CI ENGINES
Pollutant formation in CI engines, smoke and particulate emissions in CI engines, effects of design and operating variables on CI engine emissions. Nox and Sox formation and control. Noise pollution from automobiles, measurement and standards.
CONTROL OF EMISSIONS FROM SI AND CI ENGINES
Design of engine, optimum selection of operating variables for control of emissions, EGR, Thermal reactors, secondary air injection, catalytic converters, catalysts, fuel modifications, fuel cells, Two stroke engine pollution control.
MEASUREMENT TECHNIQUES - EMISSION STANDARDS
NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards, driving cycles – USA, Japan, Euro and India. Test procedures – ECE, FTP Tests. SHED Test – chassis dynamometers, dilution tunnels

TEXT BOOK:
1. Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563-3, 1991.
2. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2013.
3. SAE Transactions- "Vehicle Emission"- 1982 (3 volumes).
REFERENCES:
1. Obert.E.F.- "Internal Combustion Engines"- 1988.
2. Marco Nute- "Emissions from two stroke engines, SAE Publication – 1998

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		Category	L	T	P	Credit
34421AU06	**ENGINE AND VEHICLE MANAGEMENT SYSTEM**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

To study and purpose is to understand engine management system

Prerequisite

NIL

Course Objectives

1	To understand the fundamentals of automotive electronics in details.
2	To understand the types sensors
3	To impart knowledge on SI engine management system.
4	To impart knowledge on CI engine management system.
5	To understand the vehicle management systems

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Summarize the vehicle motion control and stabilization system	Understand
CO2.	Explain the fundamentals, operation, function of various sensors in an engine management system.	Understand
CO3.	Explain the fundamentals, operation, function of various fuel injection system pertain to a SI Engine	Apply
CO4.	Explain the fundamentals, operation, function of various fuel injection system pertain to a CI Engine	Apply
CO5.	Explain the fundamentals, operation, function in vehicle management system.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO2	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO3	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO4	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO5	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--

S- Strong; M-Medium; L-Low

Syllabus

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, Introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile
SENSORS
Inductive, Hall effect, hot wire, thermistor, piezo electric, piezo resistive, based sensors. Throttle position, air mass flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors
SI ENGINE MANAGEMENT
Three-way catalytic converter, conversion efficiency versus lambda. Layout and working of SI engine management systems like Bosch L-Jetronic and LH-Jetronic. Group and sequential injection techniques. Working of the fuel system components. Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop control of fuel injection and closed loop lambda control. Electronic ignition systems and spark timing control. Closed loop control of knock.
CI ENGINE MANAGEMENT
Fuel injection system parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve
VEHICLE MANAGEMENT SYSTEMS
ABS system, its need, layout and working. Electronic control of suspension – Damping control, Electric power steering, Supplementary Restraint System of air bag system – crash sensor, seat belt tightening. Cruise control. Vehicle security systems- alarms, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

TEXT BOOK:
1. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998
2. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
REFERENCES:
1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006.

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		Category	L	T	P	Credit
34421AU07	**SPECIAL TYPES OF VEHICLES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course reviews the fundamental concepts of earth moving equipments, power train concepts, sub systems of special types of vehicles, farm equipment, military and combat vehicles and special purpose vehicles for industrial applications.

Prerequisite

Nil

Course Objectives

1	To detail the working of earth moving and constructional equipments
2	To describe power train concepts
3	To explain the sub systems of special types of vehicles
4	To describe the working of farm equipments, military and combat vehicles
5	To explain the working of special purpose vehicles for industrial applications

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Describe the construction and working of earth moving and constructional equipments	Understand
CO2.	Appraise on the power trains applicable for for earth moving and constructional equipments.	Apply
CO3.	Appraise on the function of all the sub-systems for earth moving and constructional equipments.	Apply
CO4.	Appraise on the various farm equipments and military vehicles.	Apply
CO5.	Appraise on the various specially designed vehicles for industrial applications.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO2	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO3	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO4	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO5	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES
Construction layout, capacity and applications. Power Plants, Chassis and Transmission, Multivalve vehicles.
EARTH MOVING MACHINES
Earthmovers like dumpers, loaders - single bucket, Multi bucket and rotary types- bulldozers, excavators, backhoe loaders, scrappers, drag and self powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earthmoving machines.
SCRAPPERS, GRADERS, SHOVELS AND DITCHERS
Scrappers, elevating graders, motor graders, self powered scrappers and graders, Power shovel, revolving and stripper shovels – drag lines – ditchers – capacity of shovels.
FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES
Power take off, special implements. Special features and constructional details of tankers, gun carriers and transport vehicles.
VEHICLE SYSTEMS, FEATURES
Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

TEXT BOOK:

1. Off the road wheeled and combined traction devices – Ash gate Publishing Co.Lt.
2. Satyanarayana. B., Construction planning and equipment, standard publishers and distributors, New Delhi.

REFERENCES:

1. Abrosimov.K. Branberg.A and Katayer.K, Road making machinery, MIR Publishers, Moscow, 1971.
2. Bart H Vanderveen, Tanks and Transport vehicles, Frederic Warne and Co Ltd.,London.
3. Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd.
4. Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGraw Hill Publishing company Ltd.

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		Category	L	T	P	Credit
34421AU08	**TWO AND THREE WHEELER LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

To impart knowledge on clutch, gear box and performance on two and three wheeler

Prerequisite

Nil

Course Objectives

1	To understand the performance shock absorber and coil spring
2	To understand the two wheeler chain tension
3	To study three wheeler chassis frame.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Experiment with shock absorber and coil spring.	Apply
CO2.	Identify tension in the two wheeler	Apply
CO3.	Construct Three wheeler chassis frame.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-
CO2	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-
CO3	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Performance test of a shock absorber.
2. Performance test on coil spring.
3. Two wheeler chain tension test.
4. Brake and Clutch adjustment as per specification.
5. Dismantling and assembling of two wheeler gear box and finding gear ratio.
6. Dismantling and assembling of three wheeler gear box and finding gear ratios.
7. Dismantling and assembling of three wheeler steering system.
8. Study of three wheeler chassis frame and power transmission system.

Text Books

1. 'Two and Three Wheeler Lab Manual', Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission's Research Foundation (Deemed to be University), Salem

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		Category	L	T	P	Credit
34421AU09	**TWO AND THREE WHEELER TECHNOLOGY**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

To study and purpose is to understand two and three-wheeler technology

Prerequisite

NIL

Course Objectives

1	To understand the power units.
2	To understand the fuel and ignition systems
3	To understand the fuel and ignition systems
4	To understand the brakes and wheels
5	To impart the various types of two and three-wheeler case study

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	The student can understand the various systems of engines of two and three wheelers	Understand
CO2.	The student can understand the fuel and ignition system in two wheelers	Understand
CO3.	The student can understand the chassis and sub-systems in two wheelers	Apply
CO4.	The student can understand the working of brakes, wheels and tyres in two and three wheelers	Apply
CO5.	The student can understand the case studies in two wheelers	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO2	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO3	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO4	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO5	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--

S- Strong; M-Medium; L-Low

Syllabus

THE POWER UNIT
Two stroke and four stroke SI engine, merits and demerits, symmetrical and unsymmetrical port timing diagrams. Types of scavenging processes, merits and demerits, scavenging efficiency. scavenging pumps. rotary valve engine.
FUEL AND IGNITION SYSTEMS
Fuel system, Fuel injection system, Lubrication system. Magneto coil and battery coil spark ignition system. Electro ignition system. Starting system. Kick starter system
CHASSIS AND SUB-SYSTEM
Main frame, its types. Chassis and shaft drive. Single, multiple plates and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems. Shock absorbers. Panel meters and controls on handle bar.
BRAKES, WHEELS AND TYRES
Drum brakes, disc brakes, front and rear brake links layouts. spoked wheel, cast wheel. Disc wheel. Disc types. Tyres and Tubes
TWO AND THREE WHEELERS CASE STUDY
Case study of Sports bike, Motor cycles, Scooters and Mopeds - Auto rickshaws, Pick up van, Delivery van and Trailer. Servicing and maintenance. Recent developments

TEXT BOOK:
1. Irving, P.E., Motor cycle Engineering, Temple press Book, Loondon,1992
2. Bryaut, R.V., Vespa Maintenance and repair series. RAYMOND Broad, Lambretta- A practical guide to maintenance and repair, 1987
REFERENCES:
1. The Cycle Motor Manual, Temple Press Ltd., London, 1990
2. Encyclopedia of Motor cycling, 20 volumes, Marshall Cavensih, New York and London, 1989.

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		Category	L	T	P	Credit
34421AU10	VEHICLE MAINTENANCE AND SERVICING LAB	EC-SE	0	0	4	2

Preamble

To provide in house training in vehicle servicing and maintenance

Prerequisite

Nil

Course Objectives

1	To understand the clutch and gear box servicing
2	To understand the Differential unit
3	To understand the Ackermann Steering geometry

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Experiment with Gear box..	Apply
CO2.	Identify Differential unit.	Apply
CO3.	Make use of steering geometry available in four wheeler.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-
CO2	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-
CO3	S	S	S	S	-	-	-	M	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

Syllabus

LIST OF EXPERIMENTS

1. Clutch assembly and servicing
2. Gearbox assembly and servicing
3. Differential unit assembly and servicing
4. Transaxle assembly and servicing
5. Different types of rear axle assembly and servicing
6. Brake system trouble shooting
7. Wheel alignment testing
8. Ackermann Steering geometry verification
9. Electrical signal and circuits
10. Servicing of accessories such as wiper motor, A/C system

Text Books

1. 'Vehicle Maintenance and Servicing Lab Manual', Department of Automobile Engineering, VMKV engineering College, Vinayaka Mission's Research Foundation (Deemed to be University), Salem

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		Category	L	T	P	Credit
34421AU11	VEHICLE MAINTENANCE	EC-SE	3	0	0	3

Preamble

To study and purpose is to understand various vehicle maintenance

Prerequisite

Nil

Course Objectives

1	To understand the maintenance of records and schedules.
2	To understand the engine maintenance and repair and overhauling.
3	To understand the chassis maintenance and repair and overhauling
4	To impart the various electrical system maintenance service and repairs.
5	To understand the various maintenance of cooling, fuel, lubrication and body.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Summarize vehicle maintenance records and schedule	Understand
CO2.	Explain repair and overhauling of engine	Understand
CO3.	Apply maintenance, repair and overhauling of chassis drive line components	Apply
CO4.	Identify maintenance, repair and servicing of electrical systems	Apply
CO5.	Conduct maintenance, repair and servicing of cooling lubrication system, fuel system and body	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO2	S	M	M	M	--	--	--	M	--	--	--	M	M	--	--
CO3	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO4	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--
CO5	S	S	S	M	--	--	--	M	--	--	--	M	M	--	--

S- Strong; M-Medium; L-Low

Syllabus

MAINTENANCE OF RECORDS AND SCHEDULES
Importance of maintenance, preventive (scheduled) and breakdown (unscheduled) maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance..
ENGINE MAINTENANCE – REPAIR AND OVERHAULING
Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up
CHASSIS MAINTENANCE - REPAIR AND OVERHAULING
Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft and differential system. Maintenance servicing of suspension systems. Brake systems, types and servicing techniques. Steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.
ELECTRICAL SYSTEM MAINTENANCE - SERVICING AND REPAIRS
Testing methods for checking electrical components, checking battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dash board instruments.
MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY
Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance

TEXT BOOK:
1. John Doke “Fleet Management”, McGraw-Hill Co. 1984
2. Venk Spicer, “Automotive Maintenance and Trouble Shooting”.
REFERENCES:
1. James D Halderman - Advanced Engine Performance Diagnosis – PHI - 1998
2. Judge.A.W., “Maintenance of high speed diesel engines”,Chapman Hall Ltd., London.

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		Category	L	T	P	Credit
34421AU12	**VEHICLE TRANSPORT MANAGEMENT**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course reviews the methods of training and training procedure in the transport management, scheduling and fare structure of various public and private and state government undertaking vehicles , maintenance and motor vehicle act

Prerequisite

Nil

Course Objectives

1	To provide an insight on the different procedures of selecting persons for job and personnel management
2	To inculcate the various aspects of incorporating and managing a transportation system.
3	To elucidate on the calculation of costs of transportation, fare fixation and scheduling.
4	To provide the rules and regulations of transport system as per motor vehicle act of India.
5	To inculcate the aspects of maintenance of automotive vehicles.

Course Outcomes:

After Successful completion of this course, the students will be able to:

CO1.	Appraise on the various aspects of personnel management of a transport system.	Understand
CO2.	Devise a transport system for a typical town with proper systems for effective operations.	Apply
CO3.	Construct a fair table and prepare a schedule for a typical transportation system,	Apply
CO4.	Appraise on the various rules and regulations of transport system as per motor vehicle act of India.	Apply
CO5.	Develop a perfectly applicable maintenance schedule for an automotive.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO2	S	M	M	M	--	--	--	-	--	--	--	-	S	--	--
CO3	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO4	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--
CO5	S	S	S	M	--	--	--	-	--	--	--	-	S	--	--

S- Strong; M-Medium; L-Low

Syllabus

INTRODUCTION
Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.
TRANSPORT SYSTEMS
Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility forms of ownership by state, municipality, public body and private undertakings
SCHEDULING AND FARE STRUCTURE
Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling
MOTOR VEHICLE ACT
Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.
MAINTENANCE
Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear; remedies, maintenance procedure for better fuel economy, Design of bus depot layout.

TEXT BOOK:
1. John Duke, "Fleet Management", McGraw-Hill Co, USA, 1984.
2. Kitchin.L.D., "Bus Operation", III edition, Illiffee and Sons Co., London, 1992
REFERENCES:
1. Government Motor Vehicle Act, Publication on latest act to be used as on date

CourseDesigners:

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		Category	L	T	P	Credit
34421AU13	**INTRODUCTION TO ELECTRIC MOBILITY**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

To Design and develop innovative products and services in the field of Electric Vehicles in line with latest battery technology

Prerequisite - NIL

Course Objectives

The program is expected to enable the students to

- The fundamental understanding of electric vehicles over conventional ICE vehicles & benefits
- Design and develop innovative products and services in the field of Electric Vehicles in line with latest battery technology
- Create the knowledge base to enable start-up & Innovation mindset in EV space
- Improve the collaborative working among the Institution / Industries towards Communicate effectively to propagate ideas and promote teamwork
- Attain intellectual leadership skills to cater to the changing needs of power industry, academia, society, and environment

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

CO1.	Design and develop a basic electrical vehicle component & system	Apply
CO2.	Apply the learning in the field of EV like Battery technology, EV power train, Charging Infrastructure	Apply
CO3.	Apply the fundamental learning and use of modeling & simulation tools in the Problem-solving areas	Apply
CO4.	Interpret / recommend EV guidelines to Institution / Govt Bodies / Industries to work collaboratively & be as solution provider for cleaner & greener mobility.	Apply
CO5.	To work well with confidence in the areas on alternative power train in Automotive Industries.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	L	M	L	L	-	-	-	-	-		L	-	-
CO2	S	M	S	M	M	M	-	-	-	-	-		L	-	-
CO3	S	M	M	L	M	L	-	-	-	-	-		L	-	-
CO4	S	M	S	M	S	S	-	-	-	-	-		L	-	-
CO5	S	M	S	M	S	S	-	-	-	-	-		L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:

Introduction to Electric Vehicles

History of electric vehicles, Types of electric vehicles (Hybrid, Battery Electric Vehicle), Green Mobility Initiative from India, Policy Guidelines
EV trend in India, Challenges in EV growth, Comparison of Conventional Vehicles vs Electric Vehicles in Vehicle performance, power source, Efficiency.

Vehicle Dynamics & EV Subsystems

Introduction to electric components used, Forces acting on Electric vehicle, Aerodynamic drag , Rolling resistance, uphill resistance ,Power & Torque calculations, Introduction to Drive cycle, EV sub systems design (Motors, Controllers, Gears), Range and Energy calculation for 2W, 3W, 4W, Concept of Regeneration

EV Battery

Battery Chemistry, Battery design factors, Cost Vs demand curve, Why Lithium Ion batteries Battery Manufacturing basics, Research in battery chemistry, Cell design (series, Parallel, series + parallel) , Battery Management systems, Battery testing, Battery Thermal management system, Battery Life estimation, second life applications; Introduction to battery modeling in Simulink/MATLAB

EV Motors

Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency. Power & torque calculations, Three phase A/c machines.

Charging Systems & EV Economics

EV Charger Introduction Chargers: Slow or Fast charging, On-board Chargers & Public chargers, Importance of standardization in Charging systems. Charging systems in Indian Context, Battery Swapping & Battery leasing, Cost of ownership comparison between Conventional Vehicles vs Electric Vehicles Importance of Data analytics & IoT in Electric vehicles.

Text Books:

1. K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019.
2. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd., 2016.
3. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.

Reference Books

1. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. 2011
2. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.

4. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
5. Electric Powertrain, Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles; John G. Hayes, University College Cork, Ireland; G. Abas Goodarzi ; US Hybrid, California, USA
6. Guangjin Zhao, “Reuse and Recycling of Lithium-Ion Power Batteries”, John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
7. Arno Kwade, Jan Diekmann, “Recycling of Lithium-Ion Batteries: The LithoRec Way”, Springer, 2018. (ISBN: 978-3-319-70571-2)
8. T R Crompton, “Battery Reference Book-3 rd Edition”, Newnes- Reed Educational and Professional Publishing Ltd., 2000.
9. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
10. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
11. Ramu Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press.
12. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and applications, CRC Press
13. Fundamentals of Electric vehicles: Technology & Economics By Prof. Ashok Jhunjhunwala, Prof. Kaushal Jha, Prof. L Kannan, Prof. Prabhjot Kaur | IIT Madras, Course Material

Course Designers

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ELECTIVE COURSES SPECIALIZATION-ENERGY ENGINEERING

34421EE01	ALTERNATE FUEL TESTING LAB	Category	L	T	P	Credit
		EC-SE	0	0	4	2

Preamble
To impart knowledge on performance and emission characteristics on petrol and diesel engine.

Prerequisite
NIL

Course Objectives

1	To familiarize and train the students on the how to check VCR engine performance
2	To familiarize and train the students how to check the VCR engine in different methods'
3	To familiarize and train the students how to measure the emission gases of IC engine

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

CO1.	Analysis and performance testing of different oil used in VCR engine	Apply
CO2.	Analysis and performance testing of Alternate Fuel using by different component in VCR engine	Apply
CO3.	Evaluate the function of Emmision gas testing and measurements by Gas Analyzer	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	S	S	-	-	-	-	-	-	S	-		-	S		
CO2	S	L	S	L	M	-	-	-	M	-		-	S		
CO3	S	s	-	L	M	-	-	-	S	-		-	M		

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Performance Test on VCR engine using alternate fuel in different loads
2. Performance Test on VCR engine using alternate fuel in different comparison ratio.
3. Performance Test on VCR engine using alternate fuel in EGR
4. Performance Test on VCR engine using alternate fuel in Turbo Charger
5. Performance Test on VCR engine using alternate fuel in different Nuzzle hole
6. Measurement of HC, CO, CO_2, O_2 using exhaust gas analyzer.
7. Diesel Engine Smoke Measurement.
8. Study of NDIR gas Analyzer and FID.

9. Study of Chemiluminescent NOx Analyzer				
Text Books				
1	**ALTERNATE FUEL TESTING LAB Manual**			
Reference Books				
1	R.B. Gupta- “Automobile Engineering "- SatyaPrakashan			
2	Ganesan, V- “Internal Combustion Engines”- Tata McGraw-Hill Co.- 2003.			
Course Designers				
S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
1	B.Samuvel Michael	Asso.Prof Gr-II	MECH/AVIT	samuvelmichael@avit.ac.in
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		Category	L	T	P	Credit
34421EE02	**BIO ENERGY TECHNOLOGY**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble
To disseminate the technologies for utilizing bio-energy and its manifold benefits compared to conventional fossil fuels.

Prerequisite - NIL

Course Objectives

1	To provide the students the sources of biomass.
2	To make understand the students on different processes of biomethanation.
3	To study the combustion of bio fuels,
4	To study the gasification methods of biomass.
5	To provide the students on liquefied biofuels.

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

CO1.	To gain the knowledge of the basic concepts of Biomass preparation and also fuel assessments.	Understand
CO2.	To obtain the methods of biogas production and biogas plants.	Understand
CO3.	To apply the concepts of combustion processes and fuel handling systems.	Apply
CO4.	To apply the techniques for preparation of biogases and coals.	Apply
CO5.	To apply the techniques for preparation of biodiesels from vegetables.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	S	M	S	M	M	M	-	-	-	-	-	-	L	-	-
CO3	S	M	M	L	M	L	-	-	-	-	-	-	L	-	-
CO4	S	M	S	M	S	S	-	-	-	-	-	-	L	-	-
CO5	S	M	S	M	S	S	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS:
INTRODUCTION

Biomass: types – advantages and drawbacks – Indian scenario – characteristics – carbon neutrality – conversion mechanisms – fuel assessment studies – densification technologies – Comparison with coal – Proximate & Ultimate Analysis - Thermo Gravimetric Analysis – Differential Thermal Analysis – Differential Scanning Calorimetry

BIOMETHANATION

Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design – constructional details and comparison – biogas appliances – burner, luminaries and power generation – effect on engine performance

COMBUSTION

Perfect, complete and incomplete combustion - stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion – fuel and ash handling systems – steam cost comparison with conventional fuels

GASIFICATION, PYROLYSIS AND CORBONISATION

Chemistry of gasification - types – comparison – application – performance evaluation – economics – dual fuelling in IC engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning systems - Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization Techniques – merits of carbonized fuels

LIQUID BIOFUELS

History of usage of Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel health effects / emissions / performance. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications

TEXT BOOKS

1. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981
2. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester, 1984.
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986

Reference Books

1. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
2. Best Practises Manual for Biomass Briquetting, I R E D A, 1997.
3. Eriksson S. and M. Prior, The briquetting of Agricultural wastes for fuel, FAO Energy and Environment paper, 1990
4. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S

Course Designers

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		Category	L	T	P	CREDIT
34421EE03	ENERGY CONSERVATION IN THERMAL SYSTEMS	EC-SE	3	0	0	3

Preamble

This course is intended to introduce principles of energy auditing and to provide measures for energy conservation in thermal utilities

Prerequisite

NIL

Course Objectives

1	To provide him the present energy scenario and the need for energy conservation.
2	To understand energy monitoring / targeting aspects of Energy
3	To study the different measures for energy conservation and financial implications of various thermal utilities.
4	To study the different measures of energy conservation in thermal systems.
5	To provide energy conservation measures of different thermal utilities.

Course Outcomes

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

CO1	Understand the energy sources and scenario.	Understand
CO2	Understand energy monitoring / targeting aspects of Energy	Analysis
CO3	To apply the measures for energy conservation and financial implications of various thermal utilities.	Apply
CO4	To apply the concepts and performance study of different types of corrosion	Apply
CO5	Performance analysis of thermal utilities	Analysis

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO3	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO4	S	M	S	M	L	L	L	-	-	-	M	M	S	M	-
CO5	M	M	M	L	L	L	M	-	-	-	M	M	M	M	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION
Indian Energy Scenario – Types & Forms of Energy - Primary / Secondary Energy Sources – Energy Conservation – Need – EC Act 2003 : Salient Features – Energy Intensive Industries – Barriers - Roles & Responsibility of Energy Managers – Energy Auditing : Preliminary & Detailed - Benchmarking.
ENERGY MONITORING & TARGETING
Data & Information Analysis – Cost / Energy Share Diagram – Data Graphing – Break Even Analysis – Depreciation – Financial Analysis Techniques – CUSUM Technique – ESCO Concept – ESCO Contracts.
PERFORMANCE STUDY OF THERMAL UTILITIES – 1
Boiler – Stoichiometry – Combustion Principles – Heat Loss Estimation – Steam Traps – Steam Piping & Distribution – Thermic Fluid Heaters – Furnaces – Insulation & Refractories
PERFORMANCE STUDY OF THERMAL UTILITIES – 2
Introduction- forms of corrosion-pitting, intergranular, stress corrosion, corrosion fatigue, dezincification, erosion-corrosion, Crevice Corrosion, Fretting-Protection methods-PVD, CVD.
PERFORMANCE STUDY OF THERMAL UTILITIES – 3
Basics of R & A/C – COP / EER / SEC Evaluation – Psychometric Chart Analysis – Types & Applications of Cooling Towers – Basics – Performance Analysis – DG Set – Performance Prediction– Cost of Power Generation – Scope for Energy Conservation in all these
Text Books:
1 Smith, CB Energy Management Principles, Pergamon Press, NewYork, 1981 2 Hamies, Energy Auditing and Conservation; Methods Measurements, Management and Case study, Hemisphere, Washington, 1980 3 Trivedi, PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997
Reference:
1. Write, Larry C, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, 1988 2. Diamant, RME, Total Energy, Pergamon, Oxford, 1970 3. Handbook on Energy Efficiency, TERI, New Delhi, 2001 4. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)

Course Designers:

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		Category	L	T	P	Credit
34421EE04	**ENERGY LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble
To conduct experiments on various Energy Engineering devices to study the performance and its applications.

Prerequisite
NIL

Course Objectives

1	To impart practice in solar water heater.
2	To apply the practical training by using biogas plant
3	To apply the practical training by various pump and its characteristics
4	To study and apply for performance analysis and optimization of energy utilities
5	To study the Performance on various Heat Exchangers

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

CO1.	Understand the working principle of different renewable energy sources.	Apply
CO2.	Measure the properties of different fuels.	Apply
CO3.	Apply the practical training by various pump and its characteristics	Apply
CO4.	Procedure to be adopted for performance analysis and optimization of energy utilities	Apply
CO5.	To study the Performance on various Heat Exchangers	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	-	-	-	-	-	-	-	-	L	-	L		
CO2	S	L	S	L	-	-	-	-	-	-	L	-	L		
CO3	S	L	-	L	-	-	-	-	-	-	M	-	L		
CO4	S	M	L	-	-	-	-	-	-	-	M	-	L		
CO5	L	L	L	-	-	-	L	-	-	-	L	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

LIST OF EXPERIMENTS

1. Performance study in a solar water heater.
2. Characteristics study of solar photovoltaic devices.
3. Performance study of biogas plant.
4. Fuel characterization study in different fuels (proximate analysis, calorific value, viscosity, specific gravity etc.,)
5. Measurements of direct and diffused solar radiation.
6. Performance study on boiler.
7. Performance characteristics of motor test rig.
8. Computation of pump & pumping system characteristics (pump curve, system curve and BEP)
9. Analysis on fans characteristic curves
10. Performance study on various Heat Exchangers.
11. Performance characteristics of Vapour Compression Refrigeration test rig.
12. Study on fuel cell Systems.
13. Study on thermal storage systems
14. Study on biomass gasifiers.
15. Study on various alternate fuels for IC engines

Text Books

1	**ENERGY LAB Manual**

Reference Books

1	Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 1986
2	G.N. Tiwari, "Solar Energy Fundamentals Design, Modelling and applications", Narosa Publishing House, New Delhi, 2002

Course Designers

S.No	**Faculty Name**	**Designation**	**Department/ College**	**Email id**
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		Category	L	T	P	Credit
34421EE05	**ENERGY STORAGE SYSTEMS**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble
On completion of this course, the students are able to understand the concepts of various energy storage systems. Also students are able to get the knowledge on design and applications of various energy systems

Prerequisite
NIL

Course Objectives

1	To enable the student to understand the need for energy storage, devices and technologies available and their applications.
2	To study details of various energy storage systems along with applications.
3	Enabling to identify the optimal solutions to a particular energy storage application/utility.
4	To acquire knowledge on various energy storage systems.
5	To enable the student to understand the design and application of various energy storage systems.

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

CO1.	Analyze the characteristics of energy from various sources and need for storage.	Understand
CO2.	Classify various types of energy storage and various devices used for the purpose	Apply
CO3.	Identify various real time applications.	Apply
CO4.	Understand need of energy storage systems.	Understand
CO5.	Acquire knowledge pertaining to various ways to store energy, its analysis and use.	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO3	S	M	M	M	L	L	-	-	-	-	-	-	L	-	-
CO4	S	M	M	M	L	M	-	-	-	-	-	-	L	-	-
CO5	S	M	L	M	L	M	-	-	-	-	-	-	L	-	-

S-Strong;M-Medium;L-Low

SYLLABUS

UNIT-I: Introduction:

Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical,

electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT – II: Mechanical Energy Storage:

Thermal Energy storage, sensible and latent heat, phase change materials, Energy and exergy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage

UNIT – III: Electrochemical Energy storage:

Thermodynamics and Kinetics of Electrochemical Reactions. Introduction to Electrochemical Techniques, Electrochemical Energy Storage Systems (a) Advanced Rechargeable Batteries (b) Supercapacitors. Hybrid power systems: Differences/interactions between batteries and supercapacitors.

UNIT – IV: Features of Energy Storage Systems:

Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG).

UNIT-V: Design and Applications of Energy Storage:

Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage.

TEXTBOOKS

1. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
2. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
3. Handbook of battery materials by C. Daniel, J. O. Besenhard,Wiley VCH Verlag GmbH & Co. KgaA

ReferenceBooks

1. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.
2. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press.
3. Battery Systems Engineering by C. D. Rahn and C. Wang, Wiley Pub
4. Electrochemical Energy Storage for Renewable sources and grid balancing by P. T. Moseley and J. Garche, Elsevier Science
5. Compressed air energy storage by F. P. Miller, A. F. Vandome, M. B. John, VDM publishing

Course Designers

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1	A. Senthilkumar	ASSISTANT PROFESSOR(GRADE-II)	Mechanical/AVIT	senthilkumar@avit.ac.in
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		Category	L	T	P	Credit
34421EE06	**HYDROGEN AND FUEL CELL TECHNOLOGY**	**EC-SE**	**3**	**0**	**0**	**3**

PREAMBLE

To enlighten on various technological advancements, benefits and prospects of utilizing hydrogen/fuel cell for meeting the future energy requirements.

PREREQUISITE

NIL

COURSE OBJECTIVES

1	To detail on the hydrogen production methodologies, possible applications and various storage options.
2	To discuss on the working of a typical fuel cell, its types and to elaborate on its thermodynamics and kinetics.
3	To analyze the cost effectiveness and eco-friendliness of Fuel Cells.
4	To make students understand the different fuel cells and their applications.
5	To enable students to understand the economics of fuel cells.

COURSE OUTCOMES

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

CO1. Know the hydrogen production methodologies and various storage options	Understand
CO2. Know the working of fuel cell and its types with thermodynamic performance.	Understand
CO3. Understand the cost effectiveness and eco-friendliness of fuel cells.	Understand
CO4. Know the different types of fuel cells and their applications.	Understand
CO5.Understand the economics of fuel cells.	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO3
CO1	M	S	S	S	S	S	S						L		
CO2	S	S	S	M	M	M	L						L		
CO3	M	L	--	--	M	M	S						L		
CO4	S	M	M	--	M	M	M						L		
CO5	M	L	--	--	L	L	L						L		

S- Strong; M-Medium; L-Low

SYLLABUS

HYDROGEN – BASICS AND PRODUCTION TECHNIQUES: Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

HYDROGEN STORAGE AND APPLICATIONS: Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Safety and management of hydrogen. Applications of Hydrogen.

FUEL CELLS: History – principle - working - thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery Vs fuel cell.

FUEL CELL – TYPES: Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits.

APPLICATION OF FUEL CELL AND ECONOMICS: Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells**.**

TEXT BOOKS:

1. Viswanathan, B and M Aulice Scibioh, Fuel Cells – Principles and Applications, Universities Press (2006)
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma (2005
3. Bent Sorensen (Sørensen), Hydrogen and Fuel Cells: Emerging Technologies and Applications, Elsevier, UK (2005)

REFERENCES:

1. Kordesch, K and G.Simader, Fuel Cell and Their Applications, Wiley-Vch, Germany (1996)
2. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, New York Ltd., London (1989)
3. Jeremy Rifkin, The Hydrogen Economy, Penguin Group, USA (2002).

COURSE DESIGNERS

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	WASTE ENERGY CONVERSION	**Category**	**L**	**T**	**P**	**Credit**
34421EE07	**TECHNOLOGIES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This subject deals with various techniques involved in waste treatment, waste disposal and how to convert energy from that waste. Detailed study extends to the method of thermo chemical and bio chemical conversion techniques. Also deals a case study of environmental and health impact due energy conversion to waste.

Prerequisite - NIL

Course Objectives

1	To understand the waste and waste processes.
2	To understand waste treatment and disposal.
3	To apply how to convert waste to energy from thermo chemical conversion.
4	To apply how to convert waste to energy from bio chemical conversion.
5	To analysis the environmental impact due to waste with case study.

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

CO1.	Explained types of waste and source of waste	understand
CO2.	Understand various waste treatment and disposal	understand
CO3.	Apply the various techniques to convert waste to energy by thermo chemical conversion.	apply
CO4.	Apply various methods to convert waste to energy from bio chemical conversion.	apply
CO5.	Analysis the environmental and health impacts due to waste with case study.	analysis

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	L	-	-	-	-	-	-	-	-	-	L	-	-
CO4	S	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO5	S	S	S	M	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO WASTE & WASTE PROCESSING

Definitions, sources, types and composition of various types of wastes; Characterisation of Municipal SolidWaste (MSW) , Industrial waste and Biomedical Waste (BMW), waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of MSW; Life Cycle Analysis (LCA), Material Recovery Facilities (MRF), recycling processes of solid waste.

WASTE TREATMENT AND DISPOSAL

Aerobic composting, incineration, different type of incineration; medical and pharmaceutical waste incinerations- land fill classification, types, methods and sitting consideration, layout and preliminary design of landfills: composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.

ENERGY FROM WASTE-THERMO CHEMICAL CONVERSION

Sources of energy generation, incineration, pyrolysis, gasification of waste using gasifiers, briquetting, utilization and advantages of briquetting,-environmental and health impacts of incineration; strategies for reducing environmental impacts.

ENERGY FROM WASTE- BIO-CHEMICAL CONVERSION

Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion- biogas production, land fill gas generation and utilization, present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages.

ENVIRONMENTAL AND HEALTH IMPACTS-CASE STUDIES

Environmental and healthimpacts of waste to energy conversion, case studies of commercial waste to energy plants,waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions - Rules related to the handling, treatment and disposal of MSW and BMW in India.

Text Books

1	Parker, Colin, & Roberts, "Energy from Waste An Evaluation of Conversion Technologies", Elsevier Applied Science, London, 1985.
2	Shah, Kanti L., "Basics of Solid & Hazardous Waste Management Technology", Prentice Hall, 2000.

Reference Books

1	Robert Green, From Waste to Energy, Cherry Lake Publication, 2009.
2	Velma I Grover and Vaneeta Grover, "Recovering Energy from Waste Various Aspects", Science Pub Inc, 2002.

Course Designers

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34421EE08	ENERGY CONSERVATION AND MANAGEMENT	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

The aim of the subject is to provide basic knowledge of energy consumption, utilization and energy auditing

Prerequisite

NIL

Course Objectives

1	To compare the energy consumption details worldwide.
2	Analyzing and interpretation of energy data in industries.
3	Carrying out energy accounting and balancing.
4	Conducting energy audit and suggest methodologies for energy savings in various equipment.
5	To utilize the available energy resources in optimal ways.

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

CO1.	To gain the knowledge of the basic concepts of Energy scenario, energy auditing &role of energy managers
CO2.	To obtain the methods of Electric managements, Lightings
CO3.	To apply the concepts of boiler testing, steam distribution & thermal insulators
CO4.	To apply the techniques for Energy conservation in pumps, fans and Refrigeration
CO5.	To apply the techniques for payback period, energy management & internal rate of Return

Mapping with Programme Outcomes and Programme Specific Outcomes

Cos	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	M	L	L	-	-	-	-	-	-	L	-	-
CO2	S	M	S	M	L	L	L	-	-	-	-	-	L	-	-
CO3	S	M	M	L	M	L	M	-	-	-	-	-	L	-	-
CO4	S	M	S	M	M	M	L	-	-	-	-	-	L	-	-
CO5	S	M	S	M	M	M	L	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT

Energy-Power – Past & present scenario of World; National Energy consumption data– environmental aspects – Energy prices, policies – Energy auditing: Need, Types, methodology and analysis. Role of energy managers. Instruments used for auditing.

ELECTRICAL SYSTEMS

AC / DC current systems, Demand control, power factor correction, load management, Motor drives: motor efficiency testing, Variable frequency drives – Lighting: lighting levels, efficient options, day lighting, timers, Energy efficient windows – Advanced fuel cell technology

THERMAL SYSTEMS

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal insulation and refractories. Thermic fluid heaters.

ENERGY CONSERVATION

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

ENERGY MANAGEMENT &ECONOMICS

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

TEXT BOOKS

1. L.C. Witte, P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation, Hemisphere Publications, Washington.
2. O. Callaghn, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford.

Reference Books

1. Dryden, I.G.C. The Efficient Use of Energy, Butterworths, London
2. Turner, W.C. Energy Management Hand Book, Wiley, New York.
3. Murphy, W.R. and Mc KAY, G. Energy Management, Butterworths, London

Course Designers

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1	R.Mahesh	ASSISTANT PROFESSOR (GR-II)	Mechanical/AVIT	mahesh@avit.ac.in
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ELECTIVE COURSES SPECIALIZATION-THERMAL ENGINEERING

		Category	L	T	P	Credit
34421TE01	**COMBUSTION ENGINEERING**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

On completion of this course, the students are able to understand the concepts of combustion of fuel and flames. Also students are able to get the knowledge on consequence of various combustions.

Prerequisite

NIL

Course Objectives

1	To Acquire the fundamental knowledge of combustion.
2	To Understand the thermodynamics of combustion.
3	To Understand the kinetics of combustion.
4	To Understand the types of flames.
5	To Understand the combustion aspects in SI and CI Engines.

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

CO1.	Formulate combustion equations to determine A/F, adiabatic flame temperature and pollutant concentration.	Apply
CO2.	Relate the thermo chemistry and kinetics of combustion to evolve mathematical models for combustion.	Analyze
CO3.	Rate of physical mixing and its effects on ignition, propagation and extinction, and rate of chemical reaction once mixed.	Understand
CO4.	Identify factors responsible for laminar and turbulent flame propagation. Apply the different principles of flame stabilization and ignition to design combustor.	Apply
CO5.	Summarize emission associated with combustion and identify their control techniques	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	M	M	-	-	L	-	-	-	L	-	L		
CO2	S	S	M	-	-	-	-	-	-	-	L	-	L		
CO3	S	M	M	M	-	-	-	-	-	-	L	-	L		
CO4	S	S	M	L	-	-	M	-	-	-	M	-	L		
CO5	L	M	M	S	-	M	S	-	-	-	M	-	L		

S- Strong; M-Medium; L-Low

SYLLABUS

COMBUSTION OF FUEL

Introduction - Combustion equations - Theoretical air - Excess air - Air fuel ratio - Equivalence ratio - Exhaust gas composition - Air fuel ratio from exhaust gas composition - Heating value of fuels.

COMPRESSION IGNITION ENGINES

Thermo-chemistry, first law analysis of reacting systems - Adiabatic combustion temperature - Second law analysis of reacting systems - Criterion for chemical equilibrium - Equilibrium constant for gaseous mixtures - Evaluation of equilibrium composition - Chemical availability

KINETICS OF COMBUSTION

Rates of reaction - Reaction order and complex reactions - Chain Reactions, Arrhenius rate equation, collection theory - Activated complex theory - Explosive and general oxidative characteristics of fuels.

FLAMES

Laminar and turbulent flames - Premixed and diffusion flames - Burning velocity and its determination - Factors affecting burning velocity - Quenching, flammability and ignition - Flame stabilization in open burners

ENGINE COMBUSTION

Combustion in SI and CI engines - Stages of combustion in SI and CI engines - Normal combustion and abnormal combustion - Emissions from premixed combustion - Emission from non-premixed combustion - Control of emissions

Text Books

1	Ganesan.V, "Internal Combustion Engines", Tata McGraw-Hill, New Delhi.
2	Ramalingam.K.K, "Internal Combustion Engines - Theory and practice", SciTech Publications India Pvt. Ltd., Chennai, 2010.
3	Stephen.R.Turns, "An Introduction to Combustion concepts and applications", McGraw Hill Book Company, Boston, 3rd Edition, 2011.

Reference Books

1	Thipse.S.S, "Internal Combustion Engines", Jaico Publication House.
2	Thipse.S.S, "Alternate Fuels", Jaico Publication House.
3	Heywood.J.B, "Internal Combustion Engine Fundamentals", McGraw Hill International, New York.
4	Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons.
5	Domkundwar.V.M, "A course in Internal Combustion Engines", Dhanpat Rai & Sons.

Course Designers

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		Category	L	T	P	Credit
34421TE02	**COMPUTATIONAL FLUID DYNAMICS**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course introduces the finite difference methods as a means of solving different type of differential equations that arise in fluid dynamics. Fundamentals of numerical analysis, ordinary differential equations and partial differential equations related to fluid mechanics and heat transfer will be reviewed. Error control and stability considerations are discussed and demonstrated.

Prerequisite

NIL

Course Objectives

1	To understand basic properties of computational methods
2	To introduce Governing Equations of viscous fluid flows
3	To learn computational solution techniques for time integration of ordinary differential equations
4	To introduce numerical modeling and its role in the field of fluid flow and heat transfer
5	To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.

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

CO1.	Discuss the basic properties of computational methods	Understand
CO2.	Discuss the Governing Equations of viscous fluid flows	Understand
CO3.	Solve problems in computational solution techniques for time integration of ordinary differential equations	Analyze
CO4.	Solve problems in numerical modeling and its role in the field of fluid flow and heat transfer	Analyze
CO5.	Determine the various discretization methods, solution procedures and turbulence modeling.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	M	L	M	L	-	-	-	-	-	L	L	-	-
CO2	S	M	M	L	L	L	-	-	-	-	-	-	L	-	L
CO3	S	M	M	L	L	L	-	-	-	-	-	L	L	-	L
CO4	S	S	S	M	L	L	-	-	-	-	-	-	L	-	L
CO5	M	M	M	L	L	M	-	-	-	-	-	-	L	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Computational Fluid Dynamics, Advantages, Applications, Future of CFD. Problem set up-pre-process, Numerical solution – CFD solver

GOVERNING EQUATIONS FOR CFD

Introduction, the continuity equation, the momentum equation, the energy equation, the additional equations for turbulent flows, generic form of the governing equations for CFD, boundary conditions.

CFD TECHNIQUES

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy- Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems

FLOW FIELD ANALYSIS

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

TURBULENCE MODELS AND MESH GENERATION

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

Text Books

1	Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education Ltd. Third Edition – 2014.
2	Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd.,

Reference Books

1	John D. Anderson "Computational Fluid Dynamics - The basics with Applications", McGrawHill International Editions.
2	Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press, Reprinted 2010.
3	Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2nd Edition.
4	John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, Third Edition, 2013.

Course Designers

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34421TE03	CRYOGENIC ENGINEERING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

This course provides basic knowledge of cryogenic refrigeration systems, cryogenic instrumentation and cryogenic heat exchangers

Prerequisite

NIL

Course Objectives

1	To provide the knowledge of evolution of low temperature science
2	To provide knowledge on the properties of materials and gas separation systems
3	To familiarize with various vacuum techniques systems
4	To provide design aspects of cryogenic storage and transfer lines
5	To provide the knowledge of advances in cryogenics

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

CO1.	Understand properties of material at cryogenic temperatures	Understand
CO2.	To understand the properties of materials and gas separation systems	Understand
CO3.	Know about various vacuum techniques systems	Apply
CO4.	To understand the cryogenic refrigeration systems	Understand
CO5.	Understand the cryogenic instrumentation and cryogenic heat exchangers	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	-	M	-	-	L	-	-	-	-	L	L	-	-
CO2	S	M	-		-	-		-	-	-	L	L	L	-	-
CO3	S	M	-		-	-	M	-	-	-	-	M	L	-	-
CO4	S	M	-	M	-	-	L	-	-	-	S	M	L	-	-
CO5	S	M	-	S	-	-	L	-	-	-	S	M	L	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO CRYOGENIC SYSTEMS

Properties of materials at low temperature, Properties of Cryogenic Fluids - Air and Gas Liquefaction Systems: Thermodynamically ideal system, Production of low temperatures
Liquefaction systems for gases other than Neon, Hydrogen and Helium, liquefaction systems for Neon, Hydrogen and Helium - Cryogenic Refrigeration System

GAS SEPARATION AND GAS PURIFICATION SYSTEMS

The thermodynamically ideal separation system properties of mixtures, Principles of gas separation, air separation systems, Hydrogen, Argon, Helium air separation systems, Gas purification methods.

VACUUM TECHNIQUES

System for production of high vacuum such as mechanical, diffusion, ion and cryopumps - Cryogenics measurement systems - Temperature pressure, flow rate, liquid level measurement, Introduction to Cryo-coolers.

CRYOGENIC FLUID STORAGE SYSTEMS

Introduction, Basic Storage vessels, inner vessel, outer vessel design, piping, access manways, safetydevice. Cryogenic insulations Vacuum insulation, gas filled powders and fibrous materials, solid foam, selection and comparison of insulations. Cryogenic fluid transfer systems. Transfer through uninsulated lines, vacuum insulated lines, porous insulated lines etc.

ADVANCES IN CRYOGENICS

Vortex tube and applications, Pulse tube refrigerator, Cryogenic Engine for space vehicles. Cryogenic Applications in gas industry, cryogenic fluids, space research, Cryobiology, food processing, electronics, nuclear and high energy physics, chemical processing, metal manufacturing, cryogenic power generation, medicine, analytical physics and chemistry.

Text Books

1	Cryogenic Systems – R.F. Barron
2	Cryogenic Engineering – R.B. Scott – D.Van Nostrand Company, 1959

Reference Books

1	Cryogenic Process Engineering – K.D. Timmerhaus and T.M. Flynn, Plenum Press, New York, 1989
2	High Vacuum Technology – A. Guthree – New Age International Publication
3	Experimental Techniques in Low Temperature Physics – G.K. White – Oxford University Press, England, 1959

Course Designers

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34421TE04	DESIGN OF THERMAL POWER EQUIPMENTS	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble
This course provides knowledge of design and analysis of the heat exchangers.

Prerequisite
NIL

Course Objectives

1	To provide the knowledge of heat transfer equipment.
2	To provide knowledge on design and analysis of the Shell and tube heat exchanger
3	Enable to carry out the performance of heat exchanger with the extended surfaces.
4	To provide design and analysis of cooling towers.

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

CO1.	Design and analysis of the parallel flow, counter flow heat exchangers.	Understand
CO2.	To understand the multi-pass and cross flow heat exchangers.	Understand
CO3.	To develop the Shell and tube heat exchanger.	Apply
CO4.	To optimize the performance of heat exchanger	Understand
CO5.	To design and analyze the cooling towers	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	-	M	-	-	L	-	-	-	-	-	L	-	-
CO2	S	M	-	-	-	-		-	-	-	-	-	L	-	-
CO3	S	M	-	-	-	-	M	-	-	-	-	-	L	-	-
CO4	S	M	-	M	-	-	L	-	-	-	-	-	L	-	-
CO5	S	M	-	S	M	-	L	-	-	-	-	-	L	-	S

S- Strong; M-Medium; L-Low

SYLLABUS

CLASSIFICATION OF HEAT EXCHANGERS

Introduction, Recuperation & Regeneration – Tubular heat exchangers: double pipe, shell & tube heat exchanger, Plate heat exchangers.

BASIC DESIGN METHODS OF HEAT EXCHANGER

Introduction, Basic equations in design, Overall heat transfer coefficient – LMTD method for heat exchanger analysis – parallel flow, counter flow, multi-pass, cross flow heat exchanger design calculations.

SHELL & TUBE HEAT EXCHANGERS

Tube layouts for exchangers, baffle Heat exchangers, calculation of shell and tube heat exchangers – shell side film coefficients, Shell side equivalent diameter, the true temperature difference in a 1-2 heat exchanger, shell side pressure drop, tube side pressure drop, Analysis of performance of 1-2 heat exchanger, and design calculation of shell & tube heat exchangers.

CONDENSATION OF SINGLE VAPORS AND EXTENDED SURFACES

Evaporators and Reboilers, Vaporizing processes, forced circulation vaporizing exchangers, natural circulation vaporizing exchangers, calculations of a reboiler.
Longitudinal fins, calculation of a double pipe fin efficiency curve, calculation of a double pipe finned exchanger.

DIRECT CONTACT HEAT EXCHANGER

Cooling towers, relation between wet bulb & dew point temperatures, classification of cooling towers, cooling tower internals, Heat balance, heat transfer by simultaneous diffusion and convection. Analysis of cooling tower requirements. Calculation of cooling tower performance.

Text Books

1	Process Heat Transfer – D.Q. Kern, TMH.
2	Heat Exchanger Design – A.P.Fraas and M.N. Ozisick. John Wiely & sons, New York.

Reference Books

1	W.F. Stoecker, Design of Thermal Systems - McGraw-Hill
2	Bejan, G. Tsatsaronis, M.J. Moran, Thermal Design and Optimization – Wiley
3	N.V. Suryanarayana, Design & Simulation of Thermal Systems – MGH.

Course Designers

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	HEAT EXCHANGERS-FUNDAMENTALS AND	**Category**	**L**	**T**	**P**	**Credit**
34421TE05	**DESIGN ANALYSIS**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

Heat Exchangers are systems used in most of the conventional and non-conventional power plants around the world for transferring heat from one source of energy into another for the purpose of power generation. Power and energy are the significant elements of everyday scenario in the world and heat exchangers are one of the most important equipments applied everywhere. This course provides a deep knowledge of design, construction and analysis of heat exchangers for a thorough understanding for every graduating mechanical engineer.

Course Objective

1	To inculcate a thorough knowledge on the fundamentals of heat exchangers and its applications.
2	To provide thorough procedure for design of shell and tube heat exchangers.
3	To provide thorough design procedure of condensers.
4	To detail on the different types of compact heat exchangers, heat pipes and its applications.
5	To detail on the methods and means of analysing heat exchangers for stresses occurring during its working .

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

CO1.	Select a suitable type of heat exchanger for an application duly analysing the different requirements .	Analyze
CO2.	Design a shell and tube heat exchanger with reference to a particular type of application.	Apply
CO3.	Design a condenser for an industrial application .	Apply
CO4.	Appropriately choose a type of compact heat exchanger for an heat transfer equipment.	Analyze
CO5.	Analyse a designed heat exchanger for suitability in a preferred application.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	M	M	S	S	-	S	S	-	-	-	-	L	-	-
CO2	M	M	S	S	S	-	S	S	L	-	-	L	L	-	-
CO3	M	M	S	S	S	-	S	S	L	-	-	L	L	-	-

CO4	M	M	M	S	S	-	S	S	-	-	-	-	L	-	-
CO5	M	M	M	S	S	-	S	S	-	-	-	L	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

FUNDAMENTALS OF HEAT EXCHANGERS

Review of heat transfer modes and governing laws and equations. Introduction to heat exchangers - purpose, usage and applications of heat exchangers. Principles and methods of working of heat exchangers, Classification of heat exchangers – based on process function, flow arrangements, design, and based on applications. Recuperative and Regenerative heat exchangers.

Parameters for basic design of heat exchanger - overall heat transfer coefficient, LMTD method for heat exchanger analysis for parallel, counter, multi-pass and cross-flow heat exchanger, e-NTU method for heat exchanger analysis, TEMA code, J-factors.

DESIGN OF SHELL AND TUBE HEAT EXCHANGERS

Shell and Tube heat exchanger for single phase heat transfer – types , features of shell and tube heat exchanger, thermal design considerations, fouling considerations, selection of fluids for tube and shell side, process design procedure, problems on design of shell and tube heat exchanger.

DESIGN OF CONDENSERS

Shell and tube heat exchanger for two phase heat transfer – physical mechanism of condensation, types of condensers, condenser design, de-superheating and sub-cooling. Reboiler – types and application.

COMPACT HEAT EXCHANGERS & HEAT PIPES

Enhancement of heat transfer compact heat exchangers, extended surface heat transfer, extended surface heat exchangers, performance evaluation of heat transfer enhancement technique, pinch analysis. Finned tube heat exchanger, plate fin heat exchanger, pressure drop and multi stream analysis, phase change heat exchangers.

Heat Pipes, heat pipe heat exchangers. Regenerators, Fixed bed regenerator analysis, design and simulation of regenerator, Problems in fixed bed regenerator. Micro heat exchanger – introduction, Micro scale heat transfer, micro channel, micro heat exchanger.

ANALYSIS OF HEAT EXCHANGERS

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses – types of failure, buckling of tubes, flow induced vibration. Heat exchanger network synthesis, heat exchanger testing.

Reference Books

1	Dutta B.K. „Heat Transfer-Principles and Applications", PHI Pvt. Ltd., New Delhi, 1st ed. 2006.
2	D. Q. Kern, Process Heat Transfer, McGraw-Hill Book Company, Int. ed. 1965.
3	John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.
4	Indian Standard (IS: 4503-1967): Specification for Shell and Tube Type Heat Exchangers, BIS 2007, New Delhi.

Course Designer

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		Category	L	T	P	Credit
34421TE06	POWER PLANT ENGINEERING	EC-SE	3	0	0	3

Preamble

Power Plant Engineering is the subject involving study of applying the thermal engineering concepts and machineries in the process of power generation. Power Plants are the backbone of a country involving in the generation of electric power.

Prerequisite - Nil

Course Objectives

1	To understand the objectives of power plants in a country's electrical power requirement.
2	To understand the operational methods of power generation using different energy sources.
3	To provide the knowledge of instrumentation involved in the operation and control of power plants
4	To estimate the cost and economics of power generation in different types of power plants.
5	To inculcate the knowledge of environmental impact of power plants on the society.

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

CO1	Understand the methods of power generation using different energy sources	Understand
CO2	To state the instrumentation and control systems for a power plant	Understand
CO3	To calculate the cost of power generation for a typical power plant	Apply
CO4	To infer the environmental impacts of power plants on the society	Apply
CO5	Prepare a layout for different power plants	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	M	M	S	-	-	-	-	-	-	-	-	-	M	M	M
CO2	S	M	M	M	M	-	-	-	-	-	-	-	M	S	M
CO3	M	S	S	S	-	-	-	-	-	-	-	-	M	M	S
CO4	M	S	S	S	M	M	S	-	-	-	-	-	M	M	S
CO5	S	S	S	S	S	S	-	-	-	-	-	-	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Power Generation: Global Scenario, Present status of power generation in India, Role of private and governmental organizations, Load shedding, Carbon credits, Power reforms, concept of cascade efficiency.

General layout of modern power plant with different circuits, working of thermal power plant, coal classification, coal, ash and dust handling, selection of coal for Thermal Power Plant, FBC boilers, high pressure boiler, cogeneration power plant (with numerical)

Steam Condenser: Necessity of steam condenser, Classification, Cooling water requirements, Condenser efficiency, Vacuum efficiency, Cooling towers, air Leakage, Effects of Air Leakage on condenser performance, (Numerical Treatment)

HYDROELECTRIC AND NUCLEAR POWER PLANTS

HEPP: Introduction, Plant Layout, Site Selection, Advantages and Disadvantages of HEPP, Hydrograph, Flow duration curve, Mass Curve, Classification of HEPP with layout.

NPP : Elements of NPP, Nuclear reactor & its types, fuels moderators, coolants, control rod, classification of NPP, N-waste disposal

DIESEL & GAS TURBINE POWER PLANT

DEPP: Plant Layout, Diesel Engine Power Plant Performance Analysis, application, selection of engine size, advantages & disadvantages of diesel power plant.

GTPP : Introduction, fuels, materials selection for GTPP, Brayton Cycle analysis, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Actual cycle effect of operating variables on thermal efficiency, inter-cooling reheating, & regeneration cycle, Open, Closed & Semi Closed cycles Gas Turbine Plant , combined cycle plant (Numerical Treatment).

NON-CONVENTIONAL POWER PLANTS

Wind Power plant: Introduction, wind availability measurement, types of wind machines, site selection, and wind power generation.

Solar Power Plant: Introduction, components, Types of Collectors & Solar Ponds, Low & High Temperature Solar Power Plant. Photovoltaic Power System, Heliostat

Tidal, OTEC, geothermal, magneto hydrodynamics, fuel cell, hybrid power plants, Challenges in commercialization of Non-Conventional Power Plants.

INSTRUMENTATION , ECONOMICS AND ENVIRONMENTAL IMPACT

Power Plant Instrumentation Layout of electrical equipment, generator, exciter, short circuits & limiting methods, switch gear, circuit breaker, power transformers, methods of earthing, protective devices & Control system used in power plants, Control Room.

Economics of Power Generation: Introduction, Cost of electric energy, Fixed and operating cost, (with

numerical treatment), Selection and Type of generation, Selection of generation equipment, Performance and operation characteristics of power plants and Tariff methods.

Environmental impact due to power plants. Environmental aspects, introduction, constituents of atmosphere, different pollutants due to thermal power plants and their effects of human health, Environmental control of different pollutant such as particulate matter, Oxides of sulphur, nitrogen, global warming & green house effect, thermal pollution of water & its control. Noise pollution by power plants.

Text Books

1	E.I.Wakil, ―Power Plant Engineering‖, McGraw Hill Publications New Delhi
2	P.K.Nag, ―Power Plant Engineering‖, McGraw Hill Publications New Delhi
3	K K Ramalingam ,‖ Power Plant Engineering, SCITECH Publications Pvt Ltd.
4	Domkundwar & Arora, ―Power Plant Engineering‖, Dhanpat Rai & Sons, New Delhi

Reference Books

1	R.K.Rajput, ―Power Plant Engineering‖, Laxmi Publications New Delhi
2	R.Yadav , ―Steam and Gas Turbines‖ ,Central Publishing House, Allahabad
3	G.D.Rai, ― Non-Conventional Energy Sources‖ Khanna Publishers,Delhi
4	S.P.Sukhatme, ―Solar Energy‖ Tata McGraw-Hill Publications, New Delhi

Course Designers

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34421TE07	REFRIGERATION AND AIR-CONDITIONING	Category	L	T	P	Credit
		EC-SE	3	0	0	3

Preamble

This course provides the underlying principles of operation in different Refrigeration & Air conditioning systems and components.

Prerequisite

NIL

Course Objectives

1	To impart knowledge on refrigeration cycles and methods to improve performance
2	To familiarize the components of refrigeration systems
3	To Perform psychrometric calculations
4	To introduce air conditioning systems
5	To know the applications of refrigeration and air conditioning systems

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

CO1.	Carry out analysis of refrigeration cycles	Understand
CO2.	Understand the principles refrigeration of air-conditioning and basic design considerations.	Understand
CO3.	Perform psychrometric calculations, humidity control and analysis of air-conditioning processes	Apply
CO4.	Apply the concepts of indoor environmental comfort.	Apply
CO5.	Know the various applications of Refrigeration and air conditioning	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	S	L	-	L	-	-	L	-	-	-	-	L	L	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	L	L	-	-
CO3	S	S	M	M	-	-	-	-	-	-	-	-	M	-	-
CO4	S	S	M	M	-	-	-	-	-	-	-	-	M	-	-
CO5	S	M	-	M	M	-	L	-	-	-	-	M	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

REFRIGERATION CYCLE

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage and multiple evaporator Systems – cascade system – COP comparison. Air Refrigeration cycles.

REFRIGERANTS AND SYSTEM COMPONENTS

Compressors – reciprocating and rotary (elementary treatment), Types of condensers, vaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

PSYCHROMETRY

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning.

AIR CONDITIONING SYSTEMS

Cooling load calculation working principles of – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

UNCONVENTIONAL REFRIGERATION CYCLES

Vapor Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. APPLICATIONS – ice plant – food storage plants – milk – chilling plants.

Text Books

1	Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983.
2	Arora C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

Reference Books

1	Roy. J. Dossat, "Principles of Refrigeration", Pearson Education 1997.
2	Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt.Ltd., New Delhi, 1985.
3	Stoecker N.F. and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi,1981.

Course Designers

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		Category	L	T	P	Credit
34421TE08	**TURBOMACHINERY**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble
This course is to explore the strategies in Machineries and its dynamic analysis

Prerequisite
Nil

Course Objectives

1	To learn the principles of fluid machinery.
2	To understand various fans and blowers.
3	To understand the concept of compressors.
4	To learn the concept of axial flow compressors.
5	To understand the concept of various turbines.

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

CO1.	Know about the fundamental of fluid mechanics concepts, and energy transfer from fluid and machineries	Remember
CO2.	To understand the design concepts and importance of dynamic machineries	Understand
CO3.	To understand about constructional details of compressors and performance analysis from graphs	Understand
CO4.	To know about bench marking and to utilize velocity diagrams for work done, efficiency and performance characteristics	Apply
CO5.	To know about bench marking and to utilize velocity diagrams for blade design, testing and analysis	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	M	-	-	-	-	-	-	-	M	-	-	-	M	-	-
CO2	M	-	-	L		-	-	-	M	-	-	-	L	-	-
CO3	M	-	-	-	L	-	-	L	M	-	-	-	L	-	-
CO4	M	M	-	L	S	-	-	-	M	-	-	-	M	-	-
CO5	M	-	-	-	-	-	-	-	M	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

BASIC PRINCIPLES

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless Parameters-specific speed-applications-stage velocity triangles-work and efficiency

CENTRIFUGAL FANS AND BLOWERS

Types- stage and design parameters-flow analysis in impeller blades-volute and Diffusers, losses, characteristic curves and selection, fan drives and fan noise.

CENTRIFUGAL COMPRESSOR

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and Performance curves

AXIAL FLOW COMPRESSOR

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work Done simple stage design problems and performance characteristics.

AXIAL AND RADIAL FLOW TURBINES

Stage velocity diagrams, reaction stages, losses and coefficients, blade design Principles, testing and performance characteristics

Text Books

1	Yahya, S.M., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.
2	Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.

Reference Books

1	Bruneck, Fans, Pergamom Press, 1973.
2	Shepherd, D.G., Principles of Turbo machinery, Macmillan, 1969.

Course Designers

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ELECTIVE COURSES SPECIALIZATION-AERONAUTICAL ENGINEERING

		Category	L	T	P	Credit
34421AE01	**AIRCRAFT STRUCTURES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This subject provides knowledge on the aircrafts basic structural load and the behaviours of the structure under loading condition. It will also provide the detailed study on the failure theory which provides the student a deep knowledge on designing a safe structure.

Course Objectives

1.	To remember the various methods ofjoints in the structural member.
2.	To provide the students an understanding on the static analysis of determinate and indeterminate structure.
3.	To understand the various energy methods.
4.	To apply the knowledge on structural design using different failure theories.
5.	To analyse the various industrial and thermal stresses.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Generalize the various bending of different types of member under loading.	Remember
CO2.	Calculate the Shear flow in aircraft members related to open section.	Understand
CO3.	Calculate the columns in aircraft members.	Understand
CO4.	Describe the various types of buckling of plates and the deformation of it.	Apply
CO5.	Relate the various real time problems in industries.	Analyse

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	L	S	-	-	M	L	-	-	-	-	S	L	S	L
CO2	S	S	M	M	-	-	-	-	-	-	-	-	M	L	-
CO3	S	S	M	L	-	L	-	-	L	-	-	L	L	-	-
CO4	S	M	M	S	M	-	-	-	-	-	-	-	S	S	S

CO 5	S	S	S	M	-	-	-	-	-	--	-	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	**STATICALLY DETERMINATE& INDETERMINATE STRUCTURES**	**9**

Plane truss analysis – method of joints – method of sections – method of shear – 3-D trusses – principle of super position, Clapeyron's 3 moment equation and moment distribution method for indeterminate beams.

UNIT – II	**STRESS ANALYSIS OF WING AND FUSELAGE**	**10**

Loads on an aircraft –V-n diagram – shear force and bending moment distribution over theaircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.

UNIT – III	**COLUMNS**	**10**

Euler's column curve – inelastic buckling – effect of initial curvature – the South well plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.

UNIT – IV	**UNSYMMETRICAL BENDING**	**9**

Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'K' method, neutral axis method, and principal axis method.

UNIT – V	**INDUCED STRESSES**	**7**

Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation.

TEXT BOOK:

1. Timoshenko and Gere, "Mechanics of Materials", Tata McGraw Hill, 1993.
2. Megson T M G, "Aircraft Structures for Engineering students" Elsevier Science and Technology, 2007
3. Peery and Azar, "Aircraft Structures

REFERENCES:

1. Donaldson, B.K., "Analysis of Aircraft Structures - An Introduction", McGraw Hill, 1993.
2. Bruhn E F, "Analysis and Design of Flight Vehicle Structures", Tri-State Off-set Company, USA,1985
3. Peery, D.J. and Azar,J.J., "Aircraft Structures", 2nd Edition, McGraw – Hill, N.Y, 1999.

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		Category	L	T	P	Credit
34421AE02	**AERO ENGINE LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

This course provides sufficient knowledge and creates a base for the students to develop concepts of working independently in aero engines.

Course Objectives

1	To understand the basic concepts of aero engines used in small and large aircrafts.
2	To provide practical knowledge on working of components of aero engines.
3	To develop analytical skills for trouble shooting.
4	To develop confidence in working independently on an aircraft engine.
5	To develop personality and an attitude of team work.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identify components.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills in finding faults and mal-functioning in operation.	Apply
CO4.	Categorise the troubles and pin point the technical malfunction.	Analyze
CO5.	Evaluate and modify the system to meet certain requirement.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO 2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO 3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO 4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO 5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1.	Identification of older and newer versions of piston engines and their components.
2.	Maintenance aspect – Cleaning, Visual Inspection and Dimensional checks.
3.	Crankshaft and its parts – dimensional checks and deformation analysis
4.	Fuel and oil systems - maintenance and trouble shooting.

5.	Reassembly of dismantled components.
6.	Identification of older and newer versionsof jet engine and their components.
7.	Maintenance aspect – Cleaning, Visual Inspection and Dimensional checks.
8.	Non Destructive Testing of components.
9.	Study of Ignition System of jet engine.
10.	Jet Engine –Reassembly of dismantled components.
REFERENCES:	
AERO ENGINE LAB MANUAL	

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		Category	L	T	P	Credit
34421AE03	**AERODYNAMICS LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

The aim of the subject is to provide knowledge in wind tunnel testing

Course Objectives

1	To study experimentally the aerodynamic forces on different bodies at low speeds
2	To familiarize with the Calibration of a subsonic Wind tunnel
3	To familiarize with Pressure distribution over a smooth circular cylinder
4	To familiarize with the Pressure distribution over a symmetric aerofoil
5	To familiarize with the Flow visualization studies in subsonic flows

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Collect the knowledge of various flow equations.	Remember
CO2.	Implement the working concepts of various wind tunnel.	Understand
CO3.	Utilize the knowledge and compute the results for Pressure distribution over a smooth circular cylinder.	Apply
CO4.	Implement the concept and compute relevant results for Pressure distribution over a symmetric aerofoil	Apply
CO5.	Compute the performance of Flow visualization studies in subsonic flows.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	L	-	-	-	-	-	-	-	-	-	-	-	L	L	L
CO2.	M	L	M	-	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	M	S	-	-	-	-	-	-	-	-	-	-	M	M	M
CO5.	S	S	S	-	-	-	-	-	-	--	-	S	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. Application of Bernoulli's Equation – venture meter and orifice meter.
2. Frictional loss in laminar flow through pipes.
3. Frictional loss in turbulent flow through pipes.
4. Calibration of a subsonic Wind tunnel.
5. Determination of lift for the given airfoil section.
6. Pressure distribution over a smooth circular cylinder.
7. Pressure distribution over a rough circular cylinder.
8. Pressure distribution over a symmetric aerofoil.
9. Pressure distribution over a cambered aerofoil.
10. Flow visualization studies in subsonic flows.

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		Category	L	T	P	Credit
34421AE04	**AERODYNAMICS**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This subject provides a detailed description of the methodology and the behaviour of airflow both internal and external in compressible flow regime with particular emphasis on supersonic flows. It will provide students an in-depth knowledge of the compressible flow and also about the shock waves. With this knowledge the students can also apply the experimental techniques for high speed flows.

Course Objectives

1.	To understand the fluid mechanics concepts for advanced applications
2.	To study two dimensional flows in aerodynamics
3.	To study ideal flows over wings
4.	To Study the high speed flows over airfoils, wings and airplane configurations
5.	To Study the boundary layer interaction

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Gather the knowledge of fundamental principles of fluid mechanics.	Remember
CO2.	Use the concepts of two dimensional flows in aerodynamics.	Understand
CO3.	Implement the concept and compute relevant results for ideal flow over wings.	Apply
CO4.	Compute the results for high speed flows over airfoils and wings by applying various methods	Apply
CO5.	Implement the performance of experimental techniques for high speed flows analysis	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	L	L	-	-	-	-	-	-	-	-	-	L	L	L	L
CO2.	M	M	M	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	M	S	S	M	M	-	-	-	-	-	-	-	M	M	S
CO4	S	M	S	S	S	-	-	-	-	-	-	L	S	S	S

.															
CO5.	M	S	S	S	S	-	-	-	L	--	-	M	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	**INTRODUCTION TO LOW SPEED FLOW**	**9**
Euler equation, incompressible Bernoulli's equation. circulation and vorticity, Green's Lemma and Stoke's theorem, Barotropic flow, Kelvin's theorem, Reynolds number, streamline, stream function, irrotational flow, potential function, Equi-potential lines, elementary flows and their combinations		
UNIT – II	**TWO DIMENSIONAL INVISCID INCOMPRESSIBLE FLOW**	**9**
Ideal Flow over a circular cylinder, D'Alembert's paradox, Magnus effect, Kutta-Joukowski's theorem, starting vortex, Kutta condition, real flow over smooth and rough cylinder		
UNIT – III	**SUBSONIC WING THEORY**	**9**
Vortex filament, Biot and Savart law, bound vortex and trailing vortex, horse shoe vortex, lifting line theory and its limitations, various types of wings and its applications		
UNIT – IV	**HIGH SPEED FLOW OVER AIRFOILS, WINGS AND AIRPLANE CONFIGURATION**	**9**
Critical Mach number, Drag divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule, Swept wing, Airfoils for supersonic flows, Lift, drag, Pitching moment and Centre of pressure for supersonic profiles, Shock-expansion theory, wave drag, supersonic wings, Design considerations for supersonic aircraft- aerodynamic heating.		
UNIT – V	**EXPERIMENTAL TECHNIQUES FOR HIGH SPEED FLOWS**	**9**
Wind tunnels for transonic, Supersonic and hypersonic flows, shock tube, Gun tunnels-peculiar problems in the operation of hypersonic tunnels - Supersonic flow visualization methods		
TEXT BOOK:		
1. Anderson, J. D, Modern Compressible Flow, McGraw-Hill & Co., 2002. 2. Rathakrishnan., E, Gas Dynamics, Prentice Hall of India, 2004.		
REFERENCES:		
1. Shapiro, A. H., Dynamics and Thermodynamics of Compressible Fluid Flow, Ronald Press, 1982. 2. Zucrow, M. J. and Anderson, J. D., Elements of Gas Dynamics, McGraw- Hill & Co., 1989. 3. Oosthuizen,P.H., &Carscallen,W.E., Compressible Fluid Flow, McGraw- Hill & Co., 1997.		

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		Category	L	T	P	Credit
34421AE05	**AEROSPACE PROPULSION LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

This course provides and creates a base for the students to develop concepts of working independently in aero engines.

Course Objectives

1	To understand the basic concepts of a propulsion system.
2	To provide practical knowledge on working of components of propulsion system.
3	To develop analytical skills for fault finding.
4	To develop confidence in working on an aircraft engine.
5	To develop an attitude of team work.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identify components.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills in finding faults in operation.	Apply
CO4.	Categorise the troubles and pin point the technical malfunction.	Analyze
CO5.	Evaluate and modify the system.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2.	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3.	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5.	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS

1.	Study, dismantling and identification of types of piston engine and their components.
2.	Piston Engine Components – Cleaning, Visual Inspection and Dimension checks.
3.	Study of Camshaft operation, firing order and magneto, valve timing.
4.	Study of various auxillary systems of piston engine.
5.	Piston Engine –Reassembly of dismantled components.
6.	Study, dismantling and identification of types of jet engine and their components.
7.	Jet Engine Components – Cleaning, Visual Inspection and Dimension checks.
8.	Non Destructive Testing of components.
9.	Study of various auxillary systems of jet engine.
10.	Jet Engine –Reassembly of dismantled components.
REFERENCES:	
AEROSPACE PROPULSION LAB MANUAL	

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		Category	L	T	P	Credit
34421AE06	**AEROSPACE PROPULSION**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course provides knowledge and creates a base for the students to develop a strong concept of propulsive device used in aerospace propulsion.

Course Objectives

1	To understand the basic concepts of propulsion.
2	To provide an in-depth study of propulsion subject.
3	To develop analytical skills for selection of propulsive method.
4	To develop criticizing skills for modification and designing of components.
5	To develop entrepreneurial skills.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Define principles of operation and identification of components of an engine.	Remember
CO2.	Explain working of internal combustion engines.	Understand
CO3.	Employ analytical skills for trouble shooting.	Apply
CO4.	Categorise the propulsive devices and estimate reliability.	Analyze
CO5.	Evaluate and modify the system.	Evaluate

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO2	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO3	S	S	S	S	-	-	-	-	-	-	-	-	M	M	M
CO4	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S
CO5	S	S	S	S	-	-	-	-	-	-	-	-	S	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT I	**FUNDAMENTALS OF ENGINES**	**7**
History and classifications of Aero engines, Working of gas turbine engine – Thrust equation – Efficiency, Specific fuel consumption, Methods of thrust augmentation – Characteristics of propeller, turboprop, turbofan and turbojet engines.		
UNIT II	**INLETS AND NOZZLES**	**7**
Subsonic inlets– External and internal flow pattern – inlet performance criterion –Boundary layer separation – Supersonic inlets–Theory of flow in isentropic nozzles – Losses in nozzles — Interaction of nozzle flow with adjacent surfaces – Thrust reversal		
UNIT III	**COMPRESSORS, TURBINES AND COMBUSTION CHAMBERS**	**12**
Principle of operation of centrifugal compressor – Work done and pressure rise – Elementary theory of axial flow compressor – Elementary theory of axial flow turbine– blade cooling - Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process		
UNIT IV	**ROCKETS – SOLID, LIQUID AND HYBRID**	**12**
Selection criteria of solid propellants – propellant grain design considerations – Progressive, Regressive and neutral burning in solid rockets, Liquid propellant rockets – selection of liquid propellants – various feed systems for liquid rockets –cryogenic techniques - Thrust vector control – Cooling in liquid rockets – advantages of liquid rockets over solid rockets - introduction to hybrid propulsion – advantages and limitations of hybrid propulsion		
UNIT V	**ADVANCED PROPULSION TECHNIQUES**	**7**
Electric rocket propulsion – Plasma as a fluid- Diffusion in Partially Ionized gases - Ion propulsion – Nuclear rocket, Solar Sail		

TEXT BOOK:

1. Hill, P.G. & Peterson, C.R, Mechanics & Thermodynamics of Propulsion, Addison – Wesley Longman INC, 1999.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.

REFERENCES:

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas turbine engines, CRS Press, 2008
2. SaeedFarokhi, Aircraft Propulsion, John Wiley & Sons, Inc., 2009
3. J D Mattingly, "Elements of Propulsion - Gas Turbines and Rockets ", AIAA Education Series, 2006.
4. Dan M.Goebel, Ira Katz, „Fundamentals of Electric Propulsion", John Wiley & Sons Inc, New York, 2003.

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	AIRCRAFT GENERAL ENGINEERING AND	**Category**	**L**	**T**	**P**	**Credit**
34421AE07	**MAINTENANCE PRACTICES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course will provide the student a strong knowledge on the Aircrafts basic and regular maintenance to be followed to have a smooth and safety fly.

Course Objectives

1	To remember the various maintenance practices involved in aircraft.
2	To understand the various procedures to be followed during maintenance.
3	To provide an in-depth study of the safety precautions to be followed.
4	To identify the various special problems involved in the aircraft through inspection.
5	To fully equipped with the knowledge of the flight maintenance in all the aspects.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Recall the various maintenance practices involved in aircraft.	Remember
CO2.	Demonstrate the various procedures to be followed during maintenance.	Understand
CO3.	Generalize the various primary safety precautions to be followed.	Apply
CO4.	Calculate the various special problems involved in the aircraft.	Apply
CO5.	Categorize the various flight maintenance procedures in all the aspects.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	L	M	S	-	-	-	-	-	-	-	-	S	L	L
CO2	L	M	L	L	-	-	-	-	-	-	-	-	L	M	S
CO3	S	M	S	S	-	-	-	-	-	-	-	-	M	M	S
CO4	S	M	S	S	-	-	-	-	-	-	-	-	M	S	M
CO5	S	S	M	M	-	-	-	-	-	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	AIRCRAFT GROUND HANDLING AND SUPPORT EQUIPMENT	10
Mooring, jacking, leveling and towing operations – Preparation – Equipment – precautions – Engine Starting procedures – Piston engine, turboprops and turbojets – Engine fire extinguishing – Groundpower unit.		
UNIT – II	**GROUND SERVICING OF VARIOUS SUB SYSTEMS**	**8**
Air conditioning and pressurization – Oxygen and oil systems – Ground units and their maintenance.		
UNIT – III	**MAINTENANCE OF SAFETY**	**5**
Shop safety – Environmental cleanliness – Precautions		
UNIT – IV	**INSPECTION**	**10**
Process – Purpose – Types – Inspection intervals – Techniques – Checklist – Special inspection –Publications, bulletins, various manuals – FAR Air worthiness directives – Type certificate Data sheets – ATA Specifications		
UNIT – V	**AIRCRAFT HARDWARE, MATERIALS, SYSTEM PROCESSES**	**12**
Hand tools – Precision instruments – Special tools and equipments in an airplane maintenance shop– Identifiation terminology – Specification and correct use of various aircraft hardware (i.e. nuts, bolts,rivets, screws etc) – American and British systems of specifications – Threads, gears, bearings, etc –Drills, tapes and reamers – Identification of all types of fluid line fittings. Materials, metallic and non -metallic Plumbing connectors – Cables – Swaging procedures, tests, Advantages of swaging oversplicing.		

TEXT BOOKS:

1. Kroes Watkins Delp, "Aircraft Maintenance and Repair", McGraw Hill, New York, 1993

REFERENCES:

1. A&P Mechanics, "Aircraft Hand Book", FAA Himalayan Book House, New Delhi, 1996

2. A&P Mechanics," General Hand Book", FAA Himalayan Bok House, New Delhi, 1996

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		Category	L	T	P	Credit
34421AE08	**AIRCRAFT MATERIALS AND PROCESSES**	**EC-SE**	**3**	**0**	**0**	**3**

Preamble

This course provides basic knowledge in aircraft materials and its process.

Prerequisite

NIL

Course Objectives

1. To understand the structure of solid materials, crystal structures and physical metallurgy.
2. To understand the various deformation mechanisms, failure modes and phase diagram
3. To learn the various types of heat treatment methodologies and study of corrosion behaviour of materials.
4. To know the various types of engineering materials, properties and applications.
5. To learn about the exposure to high temperature materials for space applications

Course Outcomes

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

CO1. To know the elements of aerospace materials like crystallography.	Understand
CO2. To analyse the behaviour of materials using mechanical testing methods to know the properties of materials.	Apply
CO3. Identify heat treatment methods and surface treatments to improve mechanical properties of materials for applications in engineering industries. To make an analysis of the formation and effects of corrosion on various materials and to make an analysis of the formation and effects of corrosion on various materials.	Apply
CO4. Identify materials for industrial applications based on microstructure and mechanical property relationship	Analyze
CO5. To study and analyze the different types of high temperature materials for space applications	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	M	S	M	L	-	-	-	-	-	-	-	-	L	-	-
CO3	S	M	L	M	-	-	-	-	-	-	-	-	L	-	-
CO4	S	S	L	S	-	-	-	-	-	-	-	-	L	-	-
CO5	L	S	M	S	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS
ELEMENTS OF AEROSPACE MATERIALS
Structure of solid materials – Atomic structure of materials – crystal structure – miller indices – density – packing factor – space lattices – x-ray diffraction – imperfection in crystals – physical metallurgy -general requirements of materials for aerospace applications.
MECHANICAL BEHAVIOUR OF MATERIALS
Linear and non linear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect –Notch effect testing and flaw detection of materials and components – creep and fatigue -comparative study of metals, ceramics plastics and composites.
CORROSION & HEAT TREATMENT OF METALS AND ALLOYS
Types of corrosion – effect of corrosion on mechanical properties – stress corrosion cracking –corrosion resistance materials used for space vehicles heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – effect of alloying treatment, heat resistance alloys –tool and die steels, magnetic alloys,
CERAMICS AND COMPOSITES
Introduction – powder metallurgy - modern ceramic materials – cermets - cutting tools – glass ceramic –production of semi fabricated forms - plastics and rubber – carbon/carbon composites, fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design, open and close mould processes.
HIGH TEMPERATURE MATERIALS CHARACTERIZATION
Classification, production and characteristics – methods and testing – determination of mechanical and thermal properties of materials at elevated temperatures – application of these materials in thermal protection systems of aerospace vehicles – super alloys – high temperature material characterization.
Text Books
1. Tifferton.G., "Aircraft Materials and Processes", V Edition, Pitman Publishing Co., 1995.
Reference Books
1. Martin, J.W., "Engineering Materials, Their properties and Applications", Wykedham Publications (London) Ltd., 1987. 2. VanVlack.L.H., "Materials Science for Engineers", Addison Wesley, 1985.3. 3. Raghavan.V., "Materials Science and Engineering", Prentice Hall of India, New Delhi, 1993.

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		Category	L	T	P	Credit
34421AE09	AIRCRAFT PERFORMANCE STABILITY AND CONTROL	EC-SE	3	0	0	3

Preamble

This course will provide the student a strong knowledge on the Aircrafts various stability criteria's along the different axis and the controls involved in it and also the various flight performance in different flying conditions.

Course Objectives

1	To understand the various performance of flight during cruising condition
2	To understand the various maneuvering of flight
3	To provide an in-depth study of longitudinal static stability and its control.
4	To provide an in-depth study of directional and lateral static stability
5	To identify the Stability derivatives for dynamic stability.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Relate the various performance flights according to the maneuvers.	Remember
CO2.	Explain various flight maneuvers properly.	Understand
CO3.	Demonstrate the stability criteria's along the longitudinal axis of flight.	Apply
CO4.	Demonstrate the stability criteria's along the directional and lateral axis.	Apply
CO5.	Identify varies stability derivative problems.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	M	S	-	-	-	-	-	-	-	-	-S	L	L
CO2	L	M	L	L	-	-	-	-	-	-	-	-	L	M	S
CO3	S	M	S	S	-	-	-	-	-	-	-	-	M	M	S
CO4	S	M	S	S	-	-	-	-	-	-	-	-	M	S	M
CO5	S	S	M	M	-	-	-	-	-	-	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

UNIT – I	**CRUISING FLIGHT PERFORMANCE**	**10**

International Standard Atmosphere - Forces and moments acting on a flight vehicle -Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method-Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudesfor air breathing engines. Performance of airplane in level flight - Power available and power required curves. Maximum speed in level flight - Conditions for minimum drag and power required

UNIT – II	**MANOEUVERING FLIGHT PERFORMANCE**	**11**

Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bankangle and load factor – limitations on turn - V-n diagram and load factor.

UNIT – III	**STATIC LONGITUDINAL STABILITY**	**10**

Degree of freedom of rigid bodies in space - Static and dynamic stability - Purpose of controls in airplanes - Inherently stable and marginal stable airplanes – Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Powereffects - Stick fixed neutral point -Stick free stability-Hinge moment coefficient - Stick free neutral points- Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic Balancing.

UNIT – IV	**LATERAL AND DIRECTIONAL STABILITY**	**8**

Dihedral effect - Lateral control - Coupling between rolling and yawing moments – Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect – Rudder requirements - One engineinoperative condition - Rudder lock.

UNIT – V	**DYNAMIC STABILITY**	**6**

Dutch roll and spiral instability, Auto rotation and spin, Stability derivatives for lateral and directionaldynamics.

TEXT BOOKS:

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:,Inc, NY, 1988.
2. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2004.
3. McCornick. W., "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1979.

REFERENCES:

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982.
2. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
3. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition,Issac Pitman, London, 1981.
4. McCornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

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		Category	L	T	P	Credit
34421AE10	**AIRCRAFT STRUCTURES LAB**	**EC-SE**	**0**	**0**	**4**	**2**

Preamble

The aim of the subject is to provide a practical knowledge in aircraft structure.

Course Objectives

1	To know how to find the Young's modulus of various materials.
2	To know about the fracture patterns for various materials.
3	To know about the behaviours of beam when it is subjected to various end condition.
4	To know about the loads similarity with respect to distance
5	To know which type of joint should be made to have a strong structure.

Course Outcomes

In the successful completion of the course, students will be able to

CO1.	Remember the various materials to be used for various loads.	Remember
CO2.	Understand about the various fracture patterns for various materials.	Understand
CO3.	Apply the knowledge on behaviours of beam with various end condition.	Apply
CO4.	Apply the Maxwell's Reciprocal theorem & principle of superposition on various beam condition.	Apply
CO5.	Analyze the character sticks of various material with various loading condition.	Analyze

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO 2	L	L	L	L	-	-	-	-	-	-	-	-	L	L	L
CO 3	S	S	S	S	-	-	-	-	-	-	-	M	M	M	M
CO 4	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S
CO 5	S	S	S	S	-	-	-	-	-	-	-	S	S	S	S

S- Strong; M-Medium; L-Low

LIST OF EXPERIMENTS:

1. Determination of Young's modulus of steel using mechanical extensometers.
2. Shear centre location for closed sections
3. Determination of fracture strength and fracture pattern of ductile materials.
4. Determination of fracture strength and fracture pattern of brittle materials.
5. Stress Strain curve for various engineering materials.
6. Flexibility matrix for cantilever beam
7. Verification of Maxwell's Reciprocal theorem & principle of superposition.
8. Column – Testing.

9. Unsymmetrical bending of beams
10. Riveted Joints.

REFERENCE:

Aircraft Structure Lab Manual.

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