B.Tech
Automobile Engineering

Curriculum and Syllabus

Regulation 2022

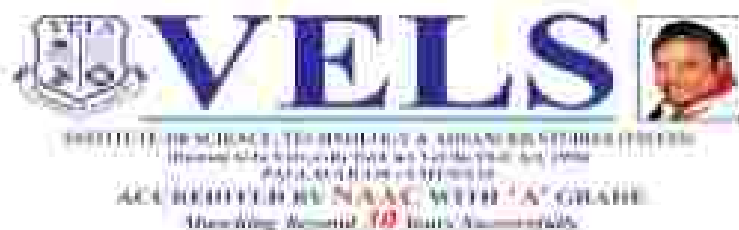(Based on Choice Based Credit System (CBCS)

and

Outcome Based Education (OBE)

Effective from the Academic year

2022-2023

Department of Automobile Engineering

School of Engineering

SCHOOL OF ENGINEERING
Department of Automobile Engineering

Vision

To impart excellent education in Automobile Engineering to develop competent and reliable engineers for industry requirement who will also carry out research on continuous basis for the betterment of society.

Mission

1: To offer superlative learning experience through innovative teaching practices supported with excellent laboratory facilities and exposure to recent trends in the automotive industry.

2: To develop comprehensive knowledge in automobile engineering with equal emphasis on theoretical and practical aspects and problem-solving skills.

3: To identify and develop industry attached laboratories so that students will familiarize with emerging industry practices.

4: To focus on Industry-Institute Interaction for improved understanding of the latest technologies, training, internship, research promotion and also encourage entrepreneurship.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO-1: The graduates shall have ability to understand and apply core subject knowledge to various automotive engineering problems.

PEO-2: The graduates will be able to work in team, investigate the problem, apply engineering knowledge and present a trustworthy solution.

PEO-3: The graduates shall be competent in continue their intellectual expansion ability for lifetime learning by pursuing higher education.

PEO-4: The graduates will exhibit professionalism in their chosen career and adapt to current technologies, trends and industrial needs.

PEO-5: The graduates shall have good communication and leadership skill, high moral and social values.

PROGRAM OUTCOMES (POS)

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: 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.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO-9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO-1: To apply the concepts of design, development, research, innovation, analysis and maintenance of automotives in the manufacturing and servicing industries.

PSO-2: To be employable in Automotive Manufacturing, Design, Production industries, academic institutes, Research and development organizations.

PSO-3: To Identify, formulate and solve automotive engineering problems in the research laboratory and perform multidisciplinary tasks in Automobile Engineering and allied areas.

Competencies and Performance Indicators

Following table gives the suggestive list of competencies and associated performance indicators for each of the PO in Automobile Engineering Program

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.	
Competency	**Indicators**
1.1 Demonstrate competence in mathematical modelling	1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems 1.1.2 Apply advanced mathematical techniques to model and solve automobile engineering problems
1.2 Demonstrate competence in basic sciences	1.2.1 Apply laws of natural science to an engineering problem
1.3 Demonstrate competence in engineering fundamentals	1.3.1 Apply fundamental engineering concepts to solve engineering problems
1.4 Demonstrate competence in specialized engineering knowledge to the program	1.4.1 Apply automobile engineering concepts to solve engineering problems

PO 2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
Competency	**Indicators**
2.1 Demonstrate an ability to identify and formulate complex engineering problems	2.1.1 Articulate problem statements and identify objectives 2.1.2 Identify engineering systems, variables, and parameters to solve the problems 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2 Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1 Reframe complex problems into interconnected sub-problems 2.2.2 Identify, assemble and evaluate information and resources 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions 2.2.4 Compare and contrast alternative solution processes to select the best process
2.3 Demonstrate an ability to formulate and interpret a model	2.3.1 Combine scientific principles and engineering concepts to formulate models (mathematical or otherwise) of a system or process that is appropriate in terms of applicability and required accuracy 2.3.2 Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required

2.4 Demonstrate an ability to execute a solution process and analyze results	2.4.1 Apply engineering mathematics and computations to solve mathematical models
	2.4.2 Produce and validate results through skillful use of contemporary engineering tools and models
	2.4.3 Identify sources of error in the solution process, and limitations of the solution
	2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

PO 3: Design Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

Competency	Indicators
3.1 Demonstrate an ability to define a complex open-ended problem in engineering terms	3.1.1 Recognize that need analysis is key to good problem definition
	3.1.2 Elicit and document, engineering requirements from stakeholders
	3.1.3 Synthesize engineering requirements from a review of the state-of-the-art
	3.1.4 Extract engineering requirements from relevant engineering Codes and Standards such as ASME, ASTM, BIS, ISO and ASHRAE
	3.1.5 Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
	3.1.6 Determine design objectives, functional requirements and arrive at specifications
3.2 Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1 Apply formal idea generation tools to develop multiple engineering design solutions
	3.2.2 Build models prototypes to develop a diverse set of design solutions
	3.2.3 Identify suitable criteria for the evaluation of alternate design solutions
3.3 Demonstrate an ability to select an optimal design scheme for further development	3.3.1 Apply formal decision-making tools to select optimal engineering design solutions for further development
	3.3.2 Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4 Demonstrate an ability to advance an engineering design to defined end state	3.4.1 Refine a conceptual design into a detailed design within the existing constraints (of the resources)
	3.4.2 Generate information through appropriate tests to improve or revise the design

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Competency	Indicators

Competency	Indicators
4.1 Demonstrate an ability to conduct investigations of technical issues consistent with the level of knowledge and understanding	4.1.1 Define a problem, its scope and importance for purposes of investigation 4.1.2 Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation 4.1.3 Apply appropriate instrumentation and/or software tools to make measurements of physical quantities 4.1.4 Establish a relationship between measured data and underlying physical principles
4.2 Demonstrate an ability to design experiments to solve open-ended problems	4.2.1 Design and develop an experimental approach, specify appropriate equipment and procedures 4.2.2 Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3 Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1 Use appropriate procedures, tools and techniques to conduct experiments and collect data 4.3.2 Analyze data for trends and correlations, stating possible errors and limitations 4.3.3 Represent data in tabular and/or graphical forms so as to facilitate analysis and explanation of the data, and drawing of conclusions 4.3.4 Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

Competency	Indicators
5.1 Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1 Identify modern engineering tools such as computer-aided drafting, modeling and analysis; techniques and resources for engineering activities 5.1.2 Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2 Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1 Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs 5.2.2 Demonstrate proficiency in using discipline-specific tools
5.3 Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.3.1 Discuss limitations and validate tools, techniques and resources 5.3.2 Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Competency	Indicators

6.1 Demonstrate an ability to describe engineering roles in a broader context e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1 Identify and describe various engineering roles particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2 Demonstrate an understanding of professional engineering regulation, legislation and standards	6.2.1 Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.

Competency	Indicators
7.1 Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1 Identify risks impacts in the life-cycle of an engineering product or activity 7.1.2 Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2 Demonstrate an ability to apply principles of sustainable design and development	7.2.1 Describe management techniques for sustainable development 7.2.2 Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Competency	Indicators
8.1 Demonstrate an ability to recognize ethical dilemmas	8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives
8.2 Demonstrate an ability to apply the Code of Ethics	8.2.1 Identify tenets of the ASME professional code of ethics 8.2.2 Examine and apply moral & ethical principles to known case studies

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Competency	Indicators
9.1 Demonstrate an ability to form a team and define a role for each member	9.1.1 Recognize a variety of working and learning preferences; appreciate the value of diversity on a team 9.1.2 Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal

Competency	Indicators
9.2 Demonstrate effective individual and team operations—communication, problem-solving, conflict resolution and leadership skills	9.2.1 Demonstrate effective communication, problem-solving, conflict resolution and leadership skills 9.2.2 Treat other team members respectfully 9.2.3 Listen to other members 9.2.4 Maintain composure in difficult situations
9.3 Demonstrate success in a team-based project	9.3.1 Present results as a team, with smooth integration of contributions from all individual efforts

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the 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

Competency	Indicators
10.1 Demonstrate an ability to comprehend technical literature and document project work	10.1.1 Read, understand and interpret technical and non-technical information 10.1.2 Produce clear, well-constructed, and well-supported written engineering documents 10.1.3 Create flow in a document or presentation – a logical progression of ideas so that the main point is clear
10.2 Demonstrate competence in listening, speaking, and presentation	10.2.1 Listen to and comprehend information, instructions, and viewpoints of others 10.2.2 Deliver effective oral presentations to technical and non-technical audiences
10.3 Demonstrate the ability to integrate different modes of communication	10.3.1 Create engineering-standard figures, reports and drawings to complement writing and presentations 10.3.2 Use a variety of media effectively to convey a message in a document or a presentation

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments

Competency	Indicators
11.1 Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1 Describe various economic and financial costs/benefits of an engineering activity 11.1.2 Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2 Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1 Analyze and select the most appropriate proposal based on economic and financial considerations

| 11.3 Demonstrate an ability to plan/manage engineering activity within time and budget constraints | 11.3.1 Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks |
| | 11.3.2 Use project management tools to schedule an engineering project, so it is completed on time and on budget |

PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Competency	Indicators
12.1 Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1 Describe the rationale for the requirement for continuing professional development
	12.1.2 Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2 Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1 Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
	12.2.2 Recognise the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
12.3 Demonstrate an ability to identify and access sources for new information	12.3.1 Source and comprehend technical literature and other credible sources of information
	12.3.2 Analyse sourced technical and popular information for feasibility, viability, sustainability, etc.

LIST OF BOARD OF STUDIES MEMBERS

S.No	Name	Affiliation	Role
1	Dr. L.KARIKALAN	*Associate Professor and Head* Dept. of Automobile Engineering VISTAS, Chennai	Chairman
2	Dr. S.PADMANABAN	*Associate Professor* Department of Automobile Engineering Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Chennai-600062	Academic Expert
3	Mr. JEROME PETER MOHANDAS	*Chief Executive Officer* Jerry Motor Company, Chennai	Industrial Expert
4	Dr. M.CHANDRASEKARAN	*Director - Mechanical* Dept. of Mechanical Engineering VISTAS, Chennai	Internal Member
5	Dr. S.RAMASUBRAMANIAN	*Associate Professor* Dept. of Automobile Engineering VISTAS, Chennai	Internal Member
6	Dr. M.RUBAN	*Assistant Professor* Dept. of Automobile Engineering VISTAS, Chennai	Internal Member
7	Mr. K.MATHAN	*Engineer* VE Commercial Vehicles Ltd., Chennai	Alumni

B.Tech (Automobile Engineering)

Credits Per Semester

S. No	Course Category	1	2	3	4	5	6	7	8	Total Credits
1	HSC	3	-	2	2	2	2	-	-	11
2	BSC	8	8	4	7	-	-	-	-	27
3	ESC	7	10	3	-	-	-	-	-	20
4	PCC	-	-	12	15	15	14	5	0	61
5	PEC	-	-	-	-	3	6	6	3	18
6	OEC	-	-	-	-	3	3	6	6	18
7	Project	-	-	-	-	-	-	5	10	15
8	MC	-	-	-	-	-	-	-	-	-
	TOTAL	18	18	21	24	23	25	22	19	170

HSC   Humanities and Social Science Courses
BSC   Basic Science Courses
ESC   Engineering Science Courses
PCC   Professional Core Courses
PEC   Professional Elective Courses
OEC   Open Elective Courses
EEC   Employability Enhancement Courses
MC   Mandatory Courses
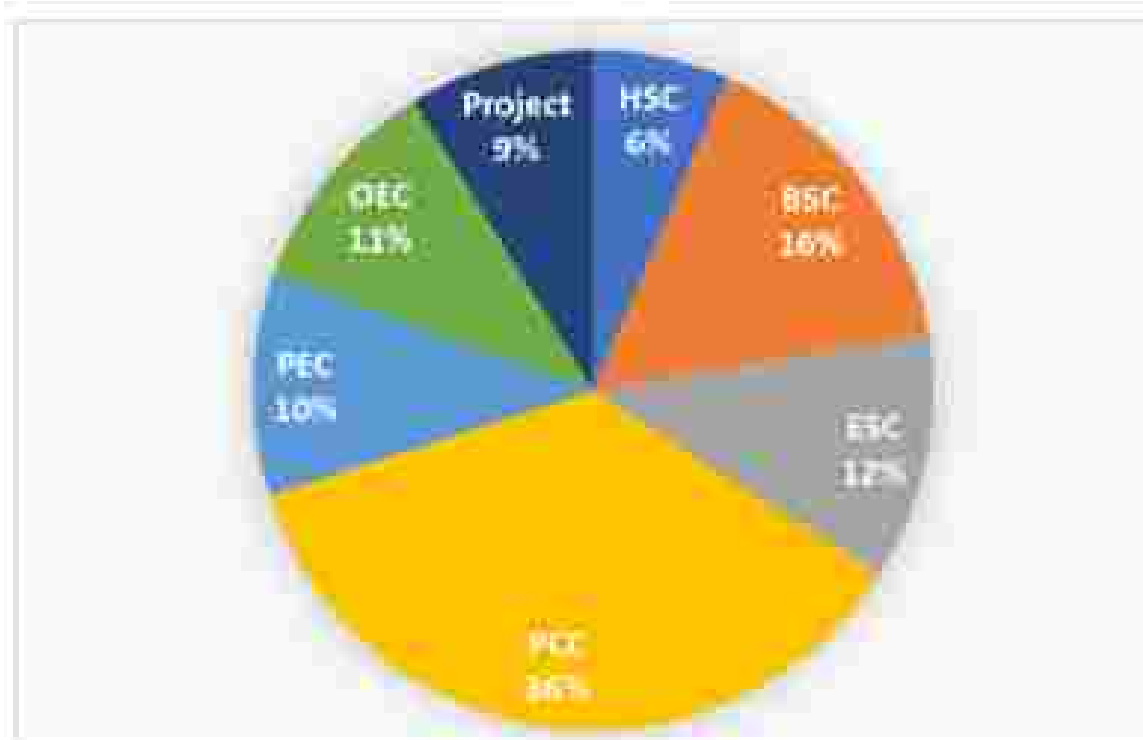
B.Tech. AUTOMOBILE ENGINEERING
CURRICULUM
(Total number of credits: 170)

Category	Course Title	L	T	P	C	CA	SEE	Total
	SEMESTER 1							
BSC	English	2	-	-	2	40	60	100
BSC	Physics (Introduction to Electromagnetic Theory)	3	-	-	3	40	60	100
BSC	Mathematics - I (Calculus and Linear Algebra)	3	1	-	4	40	60	100
ESC	Basic Electrical and Electronics Engineering	3	-	-	3	40	60	100
ESC	Engineering Graphics and Design	1	-	4	3	40	60	100
HSC	English Laboratory	-	-	2	1	40	60	100
BSC	Physics Laboratory	-	-	2	1	40	60	100
ESC	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1	40	60	100
MC	Constitution of India	2	-	-	-			100
MC	Student Induction Program	-	-	-	-	-	-	-
		14	1	10	18			

Category	Course Title	L	T	P	C	CA	SEE	Total
	SEMESTER II							
BSC	Chemistry	3	-	-	3	40	60	100
BSC	Mathematics - II (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4	40	60	100
ESC	Programming for Problem Solving	3	-	-	3	40	60	100
ESC	Engineering Mechanics	3	-	-	3	40	60	100
ESC	Workshop and Manufacturing Practices	1	-	4	3	40	60	100
BSC	Chemistry Laboratory	-	-	2	1	40	60	100
ESC	Programming for Problem Solving Laboratory	-	-	2	1	40	60	100
MC	Universal Human Values	2	-	-	-			100
		15	1	8	18			

SEMESTER III

BSC	Mathematics – III (Fourier Series and Transforms)	3	1	-	4	40	60	100
ESC	Electrical Drives and Control	3	-	-	3	40	60	100
PCC	Engineering Thermodynamics	3	-	-	3	40	60	100
PCC	Automotive Engines	3	-	-	3	40	60	100
PCC	Fluid Mechanics and Machinery	3	-	2	4	40	60	100
PCC	Automotive Engine Components Laboratory	-	-	2	1	40	60	100
PCC	Electronics and Microprocessors Laboratory	-	-	2	1	40	60	100
HSC	Personality Development – I	2	-	-	2	40	60	100
MC	Basic Life Skills	2	-	-	-			100
		19	1	6	21			

SEMESTER IV

BSC	Mathematics – IV (Statistical and Numerical Methods)	3	1	-	4	40	60	100
PCC	Engineering Metallurgy	3	-	-	3	40	60	100
PCC	Automotive Fuels and Lubricants	3	-	-	3	40	60	100
PCC	Automotive Chassis	3	-	-	3	40	60	100
PCC	Heat and Mass Transfer	3	-	2	4	40	60	100
PCC	Automotive Chassis Components Laboratory	-	-	2	1	40	60	100
PCC	Strength of Materials Laboratory	-	-	2	1	40	60	100
HSC	Personality Development – II	2	-	-	2	40	60	100
BSC	Environmental Science and Engineering	3	-	-	3	40	60	100
MC	Gender Institution and Society	2	-	-	-			100
		22	1	6	24			

	SEMESTER V							
PCC	Automotive Transmission	3	-	-	3	40	60	100
PCC	Vehicle Design Data Characteristics	3	1	-	4	40	60	100
PEC	Professional Elective – I	3	-	-	3	40	60	100
OEC	Open Elective – I (Technical)	3	-	-	3	40	60	100
PCC	Manufacturing Process of Automotive Components	3	-	2	4	40	60	100
PCC	Automotive Engine Components Design Laboratory	-	-	2	1	40	60	100
PCC	Performance and Emission Testing Laboratory	-	-	2	1	40	60	100
HSC	Personality Development - III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL-SWAYAM Course Era Math weeks) - Minimum 4 weeks	-	-	4	2			100
		17	1	10	23			

	SEMESTER VI							
PCC	Two and Three Wheelers	3	-	-	3	40	60	100
PCC	Automotive Chassis Components Design	3	1	-	4	40	60	100
PEC	Professional Elective - II	3	-	-	3	40	60	100
PEC	Professional Elective Blended	3	-	-	3	40	60	100
OEC	Open Elective - II (Technical)	3	-	-	3	40	60	100
PCC	Automotive Electrical and Electronics Systems	3	-	2	4	40	60	100
PCC	Mechatronics Laboratory	-	-	2	1	40	60	100
HSC	Personality Development - IV	2	-	-	2	40	60	100
PCC	Summer Internship (4 weeks)	-	-	4	2			100
		20	1	8	25			

SEMESTER VII

PCC	Vehicle Maintenance	3	1	-	4	40	60	100
OEC	Open Elective - III (Technical)	3	-	-	3	40	60	100
OEC	Open Elective - I (Management)	3	-	-	3	40	60	100
PEC	Professional Elective - III	3	-	-	3	40	60	100
PEC	Professional Elective	3	-	-	3	40	60	100
PCC	Vehicle Maintenance & Reconditioning Laboratory	-	-	2	1	40	60	100
Project	Project Phase I	-	-	10	5	40	60	100
		15	1	12	22			

SEMESTER VIII

PEC	Professional Elective - IV	3	-	-	3	40	60	100
OEC	Open Elective - IV (Technical)	3	-	-	3	40	60	100
OEC	Open Elective - II (Management)	3	-	-	3	40	60	100
Project	Project Phase II	-	-	20	10	40	60	100
		9	0	20	19			

B.Tech. – AUTOMOBILE ENGINEERING
CURRICULUM

LIST OF BASIC SCIENCE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22BSAU01	Physics (Introduction to Electromagnetic Theory)	3	-	-	3
22BSAU02	Mathematics - I (Calculus and Linear Algebra)	3	1	-	4
22BSAU03	Physics Laboratory	-	-	2	1
22BSAU04	Chemistry	3	-	-	3
22BSAU05	Mathematics - II (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4
22BSAU06	Chemistry Laboratory	-	-	2	1
22BSAU07	Mathematics - III (Fourier Series and Transforms)	3	1	-	4
22BSAU08	Mathematics – IV (Statistical and Numerical Methods)	3	1	-	4
22BSAU09	Environmental Science and Engineering	3	-	-	3

LIST OF ENGINEERING SCIENCE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22ESAU01	Basic Electrical and Electronics Engineering	3	-	-	3
22ESAU02	Engineering Graphics and Design	1	-	4	3
22ESAU03	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1
22ESAU04	Programming for Problem Solving	3	-	-	3
22ESAU05	Engineering Mechanics	3	-	-	3
22ESAU06	Workshop and Manufacturing Practices	1	-	4	3
22ESAU07	Programming for Problem Solving Laboratory	-	-	2	1
22ESAU08	Electrical Drives and Control	3	-	-	3

LIST OF PROFESSIONAL CORE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22PCAU01	Engineering Thermodynamics	3	-	-	3
22PCAU02	Automotive Engines	3	-	-	3
22PCAU03	Fluid Mechanics Machinery	3	-	2	4

22PCAU04	Automotive Engine Components Laboratory	-	-	2	1
22PCAU05	Electronics and Microprocessors Laboratory	-	-	2	1
22PCAU06	Engineering Metallurgy	3	-	-	3
22PCAU07	Automotive Fuels and Lubricants	3	-	-	3
22PCAU08	Automotive Chassis	3	-	-	3
22PCAU09	Heat and Mass Transfer	3	-	2	4
22PCAU10	Automotive Chassis Components Laboratory	-	-	2	1
22PCAU11	Strength of Materials Laboratory	-	-	2	1
22PCAU12	Automotive Transmission	3	-	-	3
22PCAU13	Vehicle Design Data Characteristics	3	1	-	4
22PCAU14	Manufacturing Process of Automotive Component	3	-	2	4
22PCAU15	Automotive Engine Components Design Laboratory	-	-	2	1
22PCAU16	Performance and Emission Testing Laboratory	-	-	2	1
22PCAU17	Industrial Training/ Mini Project/ MOOC Course (NPTEL-SWAYAM Course Era/ Math works) - Minimum 4 weeks	-	-	4	2
22PCAU18	Two and Three Wheelers	3	-	-	3
22PCAU19	Automotive Chassis Components Design	3	1	-	4
22PCAU20	Automotive Electrical and Electronics Systems	3	-	2	4
22PCAU21	Mechatronics Laboratory	-	-	2	1
22PCAU22	Summer Internship (4 weeks)	-	-	4	2
22PCAU23	Vehicle Maintenance	3	1	-	4
22PCAU24	Vehicle Maintenance & Reconditioning Laboratory	-	-	3	1

LIST OF PROFESSIONAL ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22PEAU01	Vehicle Dynamics	3	-	-	3
22PEAU02	Automotive Engine Components Design	3	-	-	3
22PEAU03	Automotive Pollution and Control	3	-	-	3
22PEAU04	Simulation of I C Engine Processes	3	-	-	3
22PEAU05	Vehicle Body Engineering	3	-	-	3
22PEAU06	Special Types of Vehicles	3	-	-	3
22PEAU07	Alternative Fuels and energy systems	3	-	-	3
22PEAU08	Finite Element Analysis	3	-	-	3
22PEAU09	Transport Management	3	-	-	3
22PEAU10	Automotive Aerodynamics	3	-	-	3

22PEAU11	Modern Automobile Accessories	3	-	-	3
22PEAU12	Vibration and Noise Control	3	-	-	3
22PEAU13	Advanced Theory of I.C. Engines	3	-	-	3
22PEAU14	Engine and Vehicle Management System	3	-	-	3
22PEAU15	Metrology and Measurements for Automobile Engineers	3	-	-	3
22PEAU16	Automotive Safety	3	-	-	3
22PEAU17	Off Road Vehicles	3	-	-	3
22PEAU18	Advanced Production Processes for Automotive Components	3	-	-	3
22PEAU19	Noise, Vibration and Hardness	3	-	-	3
22PEAU20	New Generation and Hybrid Vehicles	3	-	-	3
22PEAU21	Automotive Air-Conditioning	3	-	-	3
22PEAU22	Automotive Testing	3	-	-	3

LIST OF OPEN ELECTIVE (TECHNICAL) COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22GEAU01	Computer Integrated Manufacturing System	3	-	-	3
22GEAU02	Hydraulic and Pneumatic System	3	-	-	3
22GEAU03	Design of Machine Elements	3	-	-	3
22GEAU04	Waste Heat Recovery and Co-Generation	3	-	-	3
22GEAU05	Design and Analysis of Composites	3	-	-	3
22GEAU06	Computational Fluid Dynamics	3	-	-	3
22GEAU07	Metrology and Instrumentation	3	-	-	3
22GEAU08	Composite Materials & Structures	3	-	-	3
22GEAU09	Design of Jigs, Fixtures and Press Tools	3	-	-	3
22GEAU10	Robotics	3	-	-	3
22GEAU11	Supercharging and Scavenging	3	-	-	3
22GEAU12	Mechanics of Machines	3	-	-	3

LIST OF OPEN ELECTIVE (MANAGEMENT) COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22OEAU01	Principles of Management and Professional Ethics	3	-	-	3
22OEAU02	Total Quality Management	3	-	-	3
22OEAU03	Quality Control and Reliability Engineering	3	-	-	3
22OEAU04	Supply Chain Management	3	-	-	3

22OEAU05	Operations Research	3	-	-	3
22OEAU06	Energy Audit and Energy Conservation Methods	3	-	-	3
22OEAU07	Entrepreneurship Development	3	-	-	3
22OEAU08	Value Analysis and Value Engineering	3	-	-	3
22OEAU09	Industrial Marketing and Market Research	3	-	-	3
22OEAU10	Disaster Management	3	-	-	3
22OEAU11	New Product Development	3	-	-	3

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22EEAU01	Project Phase I	-	-	10	5
22EEAU02	Project Phase II	-	-	20	10

LIST OF HUMANITIES AND SOCIAL SCIENCES COURSES

Code No.	Course	Hours / Week			Credit
		Lecture	Tutorial	Practical	
22ELAU01	English	2	-	-	2
22ELAU02	English Laboratory	-	-	2	1
22HSPD01	PERSONALITY DEVELOPMENT I	2	-	-	2
22HSPD02	PERSONALITY DEVELOPMENT II	2	-	-	2
22HSPD03	PERSONALITY DEVELOPMENT III	2	-	-	2
22HSPD04	PERSONALITY DEVELOPMENT IV	2	-	-	2

LIST OF MANDATORY COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
22MCAU01	Constitution of India	2	-	-	-
22MCAU02	Universal Human Values	2	-	-	-
22MCAU03	Basic Life Skills	2	-	-	-
22MCAU04	Gender Institution and Society	2	-	-	2

22ELAU01	ENGLISH	L	T	P	Credits
		2	0	0	2

Course Objective:

- To acquire ability to speak effectively in real life situations.

- To write letters and reports effectively in formal and business situations.

- To develop listening skills for academic and professional purposes.

- To gain effective speaking and listening skills in communication.

- To develop the soft skills and interpersonal skills to excel in their career

- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

UNIT I VOCABULARY BUILDING   08
General Vocabulary – Nouns- Compound nouns, Synonyms, Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations. -Instructions.

UNIT II BASIC WRITING   08
Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Blending and Clipping, Framing questions- Yes/No types and "Wh" questions. Summarizing, Precise writing, Paragraph Writing

UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH   08
Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives& Gerund, Checklist.

UNIT IV NATURE AND STYLE OF SENSIBLE WRITING   08
Situational Dialogues, Process description, Definitions, Numerical Expressions, Recommendation, Information Transfer- Flow chart Bar chart and Pie chart, Writing introduction and conclusion.

UNIT V WRITING PRACTICES   08
Active voice and Passive voice, Making negative sentences, Tenses, Letter Writing-Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Reading Comprehension Passages.

TOTAL - 40 HOURS

Text Books:
1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai 2012.
2. Department of Humanities and Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.

3. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai. 2012.
4. Department of Humanities and Social Sciences, Anna University, "English for Engineers and Technologists" Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.
5. M.Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

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

WebLinks:
- https://ahlion.com/magazine/technical-english/
- https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

COURSE OUTCOMES:
The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

CO1:	Improve the language proficiency of a technical under-graduate In English with emphasis on Learn, Speak, Read and Write skills.	K3
CO2:	Develop listening skills for academic and professional purposes.	K5
CO3:	Acquire the ability to speak effectively in English in real life situations	K5
CO4:	Provide learning environment to practice listening, speaking, reading and writing skills	K5
CO5:	Variety of self-instructional modes of language learning and develop learner autonomy.	K5

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	-	-	-	2	2	-	2	3	3	3	3	-	2
CO 2	-	-	-	-	2	2	-	2	3	3	3	3	-	2
CO 3	-	-	-	-	-	-	2	-	1	1	1	1	-	2
CO 4	-	-	-	-	2	1	3	1	-	-	-	-	-	2
CO 5	-	1	2	2	2	2	-	2	3	3	3	3	-	2

Assessment Methods:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		

22BSAU01	PHYSICS (Introduction to Electromagnetic Theory)	L	T	P	Credits
		3	0	0	3

Course Objectives
➤ To learn the basics of electrostatics in vacuum, liner dielectric medium, magneto statics in a liner magnetic medium.
➤ To apply these fundamental principles to electromagnetic waves.

UNIT I Electrostatics in vacuum   9
General features of the Electrostatic interaction - Basic properties of charges - Coulomb's inverse square law - Super position principle – Gauss law and its application (intensity at a point due to charged sphere and cylinder) - Laplace's and Poisson's equations for electrostatic potential -Equipotential surface - Potential at a point due to a point charge.

UNIT II Electrostatics in a linear dielectric medium   9

Electric dipole – Dipole moment - Potential energy of a dipole – Electric Field - Electric field lines - Electric field due to an electric dipole (axial point and equatoral line) – Dielectrics - Types of dielectric -Dielectric constant- Electric susceptibility - Types of polarization mechanisms in dielectrics – Internal field (Lorentz method) – Clausius-Mosotti equation

UNIT III Magnetostatics in a linear magnetic medium   9
Magnetic behaviours - Biot-Savart law - Magnetic induction at a point due to a straight conductor carrying current - Ampere's circuital law - Field along the axis of a circular coil - Solenoid - Intensity of magnetisation - Magnetic susceptibility - Magnetic permeability - Classification of magnetic material - Domain theory of ferromagnetism – B-H curve

UNIT IV Faraday's law and Maxwell's equation   9
Faraday's law - Differential form of Faraday's law - Self and mutual inductance - Self-inductance of a long solenoid- Experimental determination of self-inductance (Rayleigh's method) - Mutual inductance - Maxwell's equations and their derivation - Physical significance of Maxwell's equation.

UNIT V Electromagnetic waves   9
Wave equation - Plane electromagnetic waves in vacuum (transverse nature) - Relation between electric and magnetic fields of an electromagnetic wave - Energy carried by electromagnetic waves - Hertz experiment: production and detection of electromagnetic wave - Reflection and transmission of electromagnetic waves at normal incidence

TOTAL: 45 hours

Text Books:

T1: R. Murugeshan , Electricity and Magnetism, S. Chand & Co, 2017.

T2: Tai L. Chow, Introduction To Electromagnetic Theory: A Modern Perspective, Laxmi Publications (2012).

Reference Books:

R1: David Griffiths, Introduction to Electrodynamics, Pearson Publishers, (2015).

R2: Halliday and Resnick, Physics, Wiley, (2015).

R3: Dr. Wayne M. Saslow, Electricity, Magnetism and Light, Academic Press, (2002)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc19_ph08/preview
2. https://onlinecourses.nptel.ac.in/noc19_mm16/preview
3. https://onlinecourses.nptel.ac.in/noc21_ee83/preview

COURSE OUTCOMES

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

CO1:	Analyze the charges, Gauss theorem and their applications.	K3
CO2:	Utilize the various types of polarization mechanisms in dielectrics.	K5
CO3:	Identify the applications of dielectric materials.	K5
CO4:	Select the types of magnetic materials and their applications.	K5
CO5:	Analyze the theoretical aspects of Domain theory of ferromagnetism.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	1	-	-	-	-	-	1	-
CO2	1	1	1	1	1	-	1	-	-	-	-	-	-	-
CO3	1	1	1	2	1	-	1	-	-	-	-	-	2	2
CO4	2	1	1	2	1	-	1	-	-	-	-	-	2	2
CO5	2	1	1	1	1	-	1	-	-	-	-	-	-	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		

22BSAU02	MATHEMATICS-I	L	T	P	Credits
	(Calculus and Linear Algebra)	3	1	0	4

Course Objectives:

➢ Explain the prospective engineers with techniques in calculus, multivariate analysis and linear algebra
➢ Develop the students with standard concepts and tools at an intermediate to advanced level

Unit-I: Calculus   12

Rolle's theorem-Mean value theorems-Taylor's and Maclaurin theorems -Indeterminate forms and L Hospital's rule-Curvature-radius of curvature – Evolutes and envelopes.

Unit-II: Multivariable Calculus   12

Limits-continuity- partial derivative – total derivative – maxima and minima- saddle points- method of Lagrange multipliers.

Unit-III: Sequence and series   12

Convergence of sequence and series – test for convergence- power series – Comparison test- Root test, D'Alembert's test and Leibnitz's test.

Unit-IV: Matrices   10

Introduction to Matrices- Rank of matrix- Linear system of equations-symmetric- skew symmetric matrix and orthogonal matrices-Eigen values and Eigen vectors Diagonalization of matrices- Cayley-Hamilton theorem and orthogonal transformation.

Unit-V: Vector spaces   14

Vector Space- linear Independence and dependence of vectors, basis, dimension- Linear transformations (maps), range and kernel of a linear map, rank and nullity- Inner product spaces-Gram-Schmidt Orthogonalization.

                                                        Total Hours: 60

TEXTBOOKS:

T1: G B Thomas and R L Finney, Calculus and Analytic geometry,
9thEdition,Pearson,Reprint,2002.
T2: RamanaB.V., Higher Engineering Mathematics,Tata McGraw Hill New Delhi, 11 Reprint 2010
T3: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,
Reprint, 2008.

REFERENCE BOOKS:

R1: P. Sivaramakrishna Das and C. Vijayakumari, Mathematics-I, First Edition, Pearson India
Education services Pvt. Ltd

R2: Erwinkreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley&Sons, 2006.
R3: Veerarajan T ,Engineering Mathematics for first year,TataMcGraw-Hill,NewDelhi,2008.

WEBLINK:
1. https://www.khanacademy.org/math/multivariable-calculus/applications-of-multivariable-derivatives/optimizing-multivariable-functions/a/maximums-minimums
2. https://www.geeksforgeeks.org/rolles-and-lagranges-mean-value-theorem
3. https://home.iitk.ac.in/~arlal/MTH102/la.pdf

COURSE OUTCOMES:

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

CO1:	Apply the concept of differential calculus and to evaluate the curvature, radius of curvature and envelope.	K3
CO2:	Evaluate the concept of limits, continuity and to evaluate derivatives.	K5
CO3:	Analyze the convergence of the series using root test, D'Alembert's test, Leibnitz' stest	K5
CO4:	Determine the concept of limits, continuity and to evaluate derivativeswithfunctionsofseveralvariablesthatisessentialinmost branchesofengineering.	K5
CO5:	Evaluate the linear independence and dependence of vectors, linear transformations and inner product space.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	2	2	-	-	1	1	-	1
CO2	2	1	1	2	2	2	-	-	1	1	-	1
CO3	2	1	1	2	2	2	-	-	1	1	-	1
CO4	2	1	1	2	2	2	-	-	1	1	-	1
CO5	2	1	1	2	2	2	-	-	1	1	-	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration / Presentation	Open book test
			✓		

22ESAU01	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	Credits
		3	0	0	3

Course Objectives:
- To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.
- To provide employability skill of adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.

UNIT I   DC Circuits   12

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation. Wye—Delta Transformation, Superposition, Thevenin and Norton Theorems.

UNIT II   AC Circuits   12

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

UNITIII   Transformers   12

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNITIV   Electrical Machines & Power Converters   12

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction of Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

UNIT V   Basics of Electronics   12

Intrinsic semiconductors; Extrinsic semiconductors – P-type and N-type; P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics, Binary Number System — Boolean Algebra theorems- Logic gates- Introduction to sequential Circuits– Flip-Flops.

TOTAL : 60 hours

Text Books:
T1: 1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

T2:2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

T3: John Bird, "Electrical Circuit theory and technology", Routledge, 5th edition,2013

Reference Books:

R13: L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

R24: E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

R35: V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989 Text book 1

Web Links:

1. https://www.electricaltechnology.org/category/basic-electrical-fundamentals
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES

CO1:	Understand and analyse DC circuits	K2
CO2:	Understand and analyse AC circuits	K2
CO3:	Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections.	K3
CO4:	Understand and Examine the various electrical machines and contactor circuits	K2
CO5:	Identify the basics of electronics	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22ESAU02	ENGINEERING GRAPHICS AND DESIGN	L	T	P	Credits
		1	0	4	3

Course Objectives:
- To familiarize the students in basic concept of conic sections, projections and developments of objects.
- To develop the imagination and drafting skills of students and pictorial projections.

UNIT I DIMENSIONING AND GEOMETRICAL CONSTRUCTION   12

BIS - Lettering - Two systems of dimensioning, Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES   12

Orthographic projection- Principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS   12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES   12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTION   12

General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

                                                          TOTAL : 60 hours

Text Books:
T1. Bhatt N.D. and Panchal V.M., —Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.
T2. Parthasarathy N.S and Vela Murali, —Engineering Drawing, Oxford University Press, New Delhi, 1 stEdition, 2015
Reference Books:
    R1. Natarajan K.V., —A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 31st Edition, 2015.

R2: Basant Agrawal and Agrawal C.M, —Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2013.

Web Links:
1. https://nptel.ac.in/courses/112103019
2. https://alison.com/course/diploma-in-engineering-drawing-and-computer-graphics

COURSE OUTCOMES

CO1:	Sketch the drawing standards, conventions and practices in engineering drawing	K1
CO2:	Draw the orthographic projections of points, straight lines and plane surfaces for solving some of the engineering problems in day-to-day applications.	K1
CO3:	Sketch the orthographic projections for the points, straight lines or solids using the change of position method.	K1
CO4:	Draw projections of sectioned solids and development of lateral surfaces and apply the concept to simple sheet metal work.	K6
CO5:	Draw the isometric projections for the given solids and combination of solids using box method and create 3D models	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	-	2	-	-	-	-	3	-	2	2	3
CO2	2	3	2	-	2	-	-	-	-	3	-	3	2	3
CO3	2	3	2	-	2	-	-	-	-	3	-	2	2	3
CO4	2	3	2	-	2	-	-	-	-	3	-	2	2	2
CO5	2	2	2	-	2	-	-	-	-	3	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓			✓		✓

22ELAU02	ENGLISH LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objectives:

➤ To enable the student to explore the knowledge in communication skills

➤ To gain knowledge in the process of Placement Interviews, Group Discussions and other recruitment procedures.

List of Experiments   40

1. Introduction to English sounds
2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarising
7. Report Writing
8. Information Transfer
9. Presentation Skills
10. Group Discussion
11. Letter Writing
12. Cover letter and Resume

Text Books:

1. Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai. 2012.

2. M AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

Reference Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011
3. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Weblinks:

* https://onlinemasters.ohio.edu/blog/engineering-communication/
* https://online.rice.edu/courses/communication-skills-for-engineers-specialization

Course Outcoms

CO1:	Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly	K3
CO2:	Use appropriate pronunciation and rhythm of spoken language in Oral communication	K5
CO3:	Draft and interpret the written communication in official contexts like narrative, descriptive, creative, critical and analytical reports	K5
CO4:	Infer implied meanings of different genres of texts and critically analyze and evaluate them for ideas, as well as for method of Oral presentation	K5
CO5:	Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions, negotiation and conversations	K5

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	2	-	-	-	-	-	-	2
CO2	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO3	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO4	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO5	3	2	1	1	3	1	3	3	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22BSAU03	PHYSICS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objectives

➤ To enable the student to explore the field of Electromagnetism and Properties of Matter

➤ To gain knowledge in the scientific methods and learn the process of measuring different Physical variables.

Any Eight Experiments:

1. Determination of Rigidity Modulus – Torsional pendulum
2. Determination of wavelength and particle size using laser
3. Ultrasonic Interferometer
4. Determination of band gap of a semiconductor material
5. Hooke's law – Determination of spring constant
6. Determination of Young's Modulus – Uniform Bending
7. Determination of Young's Modulus – Non Uniform Bending
8. Determination of Viscosity of a liquid - Poiseuille's method
9. Spectrometer – Grating
10. Deflection Magnetometer - Tan A position
11. Deflection Magnetometer - Tan B position
12. Potentiometer - Calibration of low range Voltmeter

Text Books:

T1:   C. C. Ouseph, U. J. Rao, V. Vijayendran, Practical Physics, 1st Edition, 2015
T2:   Biswajit Saha, Practical Physics Book, LAP LAMBERT Academic Publishing, 1st Edition, 2020.

Reference Books:

R1:   G.L. Squires, Practical Physics, 4th Edition, Cambridge University Press, 2001.
R2:   D. Chattopadhyay, P.C. Rakshit, B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990

Web Links:

1. http://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=2
2. https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1509&cnt=4

COURSE OUTCOMES

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

CO1:	Construct a circuit for voltmeter calibration.	K3
CO2:	Analyze the magnetic moments using deflection magnetometer.	K5
CO3:	Measure the wavelength and band gap of the given materials.	K5
CO4:	Determine the compressibility of the liquid using ultrasonic interferometer.	K5
CO5:	Measure the Young's modulus of the given solid materials.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	3	3	2	2	-	-	-	-	-	2	2
CO2	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO3	-	1	2	3	2	2	2	-	-	-	-	-	2	2
CO4	-	1	1	2	1	-	-	-	-	-	-	-	1	-
CO5	-	1	2	3	3	2	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams:	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22ESAU03	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objectives:

- To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.
- To expose the students to learn experimental skills about Transformers, DC Motor, Converters.

LIST OF EXPERIMENTS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculations and verification.
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage, phase-to-neutral voltage, line and phase currents).
5. Load Characteristics of a DC Motor
6. Torque - Slip Characteristic of an Induction motor
7. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
8. Demonstration of DC-DC Converter.
9. Demonstration of DC-AC converter.
10. Demonstration of AC-DC converter.

<div align="right">TOTAL: 30 h</div>

COURSE OUTCOMES

CO1:	Understand the basic safety precautions and learn to make use of measuring instruments	K2
CO2:	Analyze the steady state response of R-L, R-C circuits	K3
CO3:	Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections	K3
CO4:	Understand and Experiment with single phase induction motor and three phase induction motor	K2
CO5:	Demonstrate DC-DC, DC-AC and AC-DC converters	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓	✓	

22MCAU01	CONSTITUTION OF INDIA	L	T	P	Credits
		2	0	0	0

COURSE OBJECTIVES:
1. The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working
2. To help students be familiar with the historical and significant aspects of the constitution of India.
3. To make students aware of their fundamental duties and rights.
4. To know about central and state government functionalities in India.

UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6
Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNIT II FUNDAMENTAL RIGHTS 6
Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIES 6
Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE 6
Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNIT V AMENDMENT AND EMERGENCY PROVISIONS 6
Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

TOTAL: 30 h

TEXT BOOKS:
1. V.N. Shukla, Constitutional Law of India
2. D.D. Basu, Commentary on the Constitution of India
3. J.N. Pandey, Constitution of India
4. Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi
5. R.C Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi
6. Maciver and Page, "Society: An Introduction Analysis", Mac Milan India Ltd., New Delhi

7. K.L Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

1. V.D. Mahajan, Constitutional Law of India
2. H.M. Seervai, Constitution of India
3. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.
4. U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalaendhar
5. R.N. Sharma, "Indian Social Problems", Media Promoters and Publishers Pvt. Ltd.

Weblink:

1. https://legislative.gov.in/constitution-of-india

COURSE OUTCOMES:

CO1:	Elaborate the constitution of India and its salient features	K2
CO2:	Know the fundamental rights and duties	K2
CO3:	Discuss the Parliamentary Form of Government in India	K2
CO4:	Recognize the Directive Principles of State Policy	K3
CO5:	Understand and abide the rules of the Indian constitution and to appreciate different culture among the people	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2
CO1	-	-	-	-	-	3	-	1	-	-	-	3	3	-
CO2	-	-	-	-	-	3	2	2	-	-	-	3	3	-
CO3	-	-	-	-	-	3	2	2	1	-	-	3	3	-
CO4	-	-	-	-	-	3	2	2	1	-	-	3	3	-
CO5	-	-	-	-	-	3	3	2	1	-	-	3	3	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22BSAU04	CHEMISTRY	L	T	P	Credits
		3	0	0	3

Course Objectives

➤ To learn about the molecular orbitals, ionic interactions and periodic properties.
➤ Rationalize periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.
➤ List major chemical reactions that are used in the synthesis of molecules.

UNIT I Atomic and molecular structure, Intermolecular forces   9
and potential energy surfaces

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene, benzene and aromaticity. Valence Bond Theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions. potential energy surfaces of H_3, H_2F and HCN.

UNIT II Spectroscopic techniques and applications   9

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational, rotational spectroscopy of diatomic molecules. Morse equations and Mossbauer spectroscopy. Applications. Diffraction and scattering.

UNIT III Use of free energy in chemical equilibria   9

Thermodynamic functions: energy, entropy, free energy and fugacity. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV Periodic properties   9

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, diagonal relationship, anomalous behaviour of Lithium, carbon and Nitrogen, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V Organic reactions and synthesis of a drug molecule   9

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, coupling reaction and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 45 hours

Text Books

T1: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
T2: Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
T3: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

Reference Books

R1: Physical Chemistry, by P. W. Atkins.
R2: Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore. 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp
R3: University chemistry, by B. H. Mahan.

Web Links:

1. https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
2. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
3. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermodynamics/Chemical_Energetics/Free_Energy_and_Equilibrium
4. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Properties_of_the_Elements
5. https://www.bcebhagalpur.ac.in/wp-content/uploads/2020/03/Organic-Reactions-Synthesis-of-Drug-Molecule.pdf

COURSE OUTCOMES

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

CO1:	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	K3
CO2:	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	K5
CO3:	Analyze bulk properties and processes using thermodynamic considerations.	K5
CO4:	Classify the properties and reactivity of different types of elements based on the periodic table.	K5
CO5:	Apply the basic terms involved in an Organic reactions and synthesis of a drug molecule.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	1	-	1	-	1	1	-	1	2	-
CO2	2	1	1	1	1	-	-	1	-	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	1	-	-	1	-	-	-	-	-	-	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22BSAU05	MATHEMATICS-II (Calculus, Ordinary Differential Equations and Complex Variable)	L	T	P	Credits
		3	1	0	4

Course Objective:

➢ To learn deal with advanced level of mathematics and applications that would be essential for their disciplines.
➢ To introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of fundamental concepts of Complex Analysis.

UNIT I: MULTIVARIABLE CALCULUS (INTEGRATION)   12

Multiple Integration: Double integrals (Cartesian)–change of order of integration in double Integrals–Change of variables (Cartesian to polar) - Triple integrals (Cartesian)–orthogonal Curvilinear coordinates- Green, Gauss and Stokes theorems (statement only)–Simple problems.

UNIT II: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS   12

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

UNIT III: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER   12

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials.

UNIT IV: COMPLEX VARIABLE –DIFFERENTIATION   12

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties, Conformal mappings, Mobius transformations and their properties.

UNIT V: COMPLEX VARIABLE-INTEGRATION   12

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof)–Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Total Hours: 60 Hours

Text Books:

T1: G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
T2: S.L. Ross, Differential Equations, 3rd Edition, Wiley dia 1984.
T3: E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
T4: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
T5: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Reference Books:

R1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.

R2. E.L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

R3. J.W. Brown and R.V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004

R4. W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9thEdn. Wiley India, 2009.

Web Links:

1. https://nptel.ac.in/courses/111105134
2. https://nptel.ac.in/courses/111108081
3. https://nptel.ac.in/courses/111106100
4. https://nptel.ac.in/courses/111107111
5. https://nptel.ac.in/courses/111103070

COURSE OUTCOMES:

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

CO1:	Apply integral calculus to improper integrals.	K3
CO2:	Analyze the Applications of Differential equations in engineering	K4
CO3:	Extend the ordinary differential equation for learning advanced Engineering Mathematics	K2
CO4:	Create the functions of several variables that is essential in most branches of engineering.	K6
CO5:	Decide the essential tool of complex variable (Integration) in engineering.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	1	1	-	1	-	-
CO2	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO3	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO4	1	1	1	1	2	-	-	-	-	1	-	1	1	1
CO5	1	1	1	1	2	-	-	-	-	1	-	1	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓	✓	✓

22ESAU04	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	Credits
		3	0	0	3

Course Objectives

- To understand the basic concepts of programming – Flow chart, Pseudo code.
- To learn the fundamentals of C programming - declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations.
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

UNIT I   INTRODUCTION TO PROGRAMMING   9

Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types), Input / Output - Arithmetic expressions and precedence, Conditional Branching and Loops -Writing and evaluation of conditionals and consequent branching - Iteration and loops

UNIT II   ARRAYS AND BASIC ALGORITHMS   9

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

UNIT III   FUNCTIONS AND POINTERS   9

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers- Defining pointers, Use of Pointers in self-referential structures

UNIT IV   STRUCTURES AND UNIONS   9

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation

UNIT V   STRING FUNCTIONS AND FILES   9

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

TOTAL : 45 hours

Text Books:

T1: E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill
T2: Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill

Reference Books:

R1:Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", PrenticeHall of India
R2:Yashavant Kanetkar, "Let Us C", BPB Publications
R3:Ashok N Kamthane, "Computer Programming", Pearson Education (India)

Web Links:

W1. https://www.edx.org/course/c-programming-getting-started

COURSE OUTCOMES

CO1	Construct a pictorial representation with a stepwise procedure for solving complex Problems	K3
CO2	Develop a high level programming code using c languages	K3
CO3	Evaluate the various functional operations for solving problem	K5
CO4	Make use of various c operations like array, pointer, strings and searching method	K3
CO5	Develop a C module for a given set of instruction	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3	-	-	-	-	-	-	-	-	3
CO2	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO4	3	2	1	3	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	3	3	-	-	-	-	-	-	-	-	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓		

22ESAU05	ENGINEERING MECHANICS	L	T	P	Credits
		3	0	0	3

Course Objectives:

- At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions.

- Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium.

- He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I   BASICS AND STATICS OF PARTICLES   12

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – 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

UNIT II   EQUILIBRIUM OF RIGID BODIES   12

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 dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III   PROPERTIES OF SURFACES AND SOLIDS   12

Determination of Areas and Volumes – First moment of area and 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 – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT IV   DYNAMICS OF PARTICLES   12

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

UNIT V   FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS   12

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

TOTAL: 60 Hours

COURSE OUTCOMES:
After successful completion of the Engineering Mechanics course, the students have the ability to
CO1:   To Solve engineering problems dealing with force, displacement, velocity and acceleration.
CO2:   To evaluate problems on equilibrium of rigid bodies
CO3:   To determine the areas and volumes of surface and solids.
CO4:   To explain dynamics of particles and their relationships between motions.
CO6:   To analyze friction and elements of rigid body dynamics.

TEXT BOOKS:
1.   Beer, F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 1997.
2.   Rajasekaran S, Sankarasubramanian G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., 2000.

REFERENCE BOOKS:

1.   Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
2.   Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics and Dynamics", Tata McGraw-Hill, 2001.
3.   Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., 2003

4. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., 2002.

WEBLINKS:

1. https://www.youtube.com/watch?v=LG0YzGeAFxk
2. https://archive.nptel.ac.in/courses/112/106/112106286/

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	2	-	-	-	-	-	3	2	3
CO2	3	2	2	1	2	2	1	-	-	-	-	1	2	2
CO3	3	2	1	1	1	3	-	-	-	-	-	1	2	1
CO4	3	1	1	2	1	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	2	-	-	-	-	-	3	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration / Presentation
✓		✓		✓

22ESAU06	WORKSHOP AND MANUFACTURING PRACTICES	L	T	P	Credits
		1	0	4	3

COURSE OBJECTIVS:

1. To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
2. To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

DETAILED CONTENTS:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods   (3 lectures)
2. CNC machining, Additive manufacturing   (1 lecture)
3. Fitting operations & power tools   (1 lecture)
4. Electrical &Electronics   (1 lecture)
5. Carpentry   (1 lecture)
6. Plastic moulding, glass cutting   (1 lecture)
7. Metal casting   (1 lecture)
8. Welding (arc welding & gas welding), brazing   (1 lecture)

WORKSHOP PRACTICE:

1. **Machine shop**   9

   Machining Basics of Machining Processes Equipment's, Simple turning of cylindrical surface on MS rod using lathe machine tool. To make Facing and plain turning, step turning, drilling in the lathe

2. **Fitting shop**   9

   To make square, V joint in bench fitting as per the given dimension and tolerances. Tools and demonstration of producing model

3. **Carpentry**   9

   Basics of Carpentry operations, Equipment's ,To make half lap joint, dovetail, TEE Lap joint ,Cross halving joint of two wooden pieces at perpendicular direction

4. **Welding shop**   9

   To make single, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions. To make simple Dust pan, Rectangular trays in sheet metal with the jigs as per the given Dimensions.

5. **Plumbing Works**   9

   Study of pipeline joints, its location and functions valves, taps, couplings, unions, reducers, elbows in household fittings. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

                                                                          TOTAL: 45 hours

TEXT BOOKS:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., A Primer on Engineering PracticesLaboratory, Anuradha Publications, 2007

2. Jeyapoovan T., Saravanapandian M. & Pranitha S., Engineering Practices Lab Manual Vikas Publishing House Pvt Ltd, 2006.

REFERENCE BOOKS:

1. Bawa H.S., Workshop Practice, Tata McGraw, 2007

2. Rajendra Prasad A. & Sarma P.M.M.S., Workshop Practice, Sree Sai Publication, 2002

WEBLINKS:

1. https://www.youtube.com/watch?t=GweSNcDLvIE
2. https://www.youtube.com/watch?v=2X82Tw9XTSo
3. https://www.youtube.com/watch?v=PkpunPLMK2s

COURSE OUTCOMES

CO1:	Experiment with facing, Turning and various types of fitting joint	K 1
CO2:	Develop the half lap joint, TEE Lap joint carpentry and welding	K 5
CO3:	Practice casting, moulding, & smithy trades	K 2
CO4:	Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering	K 5
CO5:	Make a Basic pipe connections for Mixed pipe material connection and Pipe connections with different joining components	K 1

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	2	-	2	-	2	-	1	2	1	2
CO2	3	1	3	1	3	-	2	-	2	-	1	3	2	2
CO3	3	1	3	1	2	-	2	-	3	-	1	3	1	1
CO4	3	1	2	1	2	-	2	-	2	-	1	2	1	1
CO5	3	1	3	1	2	-	2	-	1	-	1	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams:	Observation	Record
	✓	✓		✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓		

		L	T	P	Credits
22BSAU06	CHEMISTRY LABORATORY	0	0	2	1

Course Objectives
- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time.
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- Synthesize a small drug molecule.

Any Eight Experiments

1. Determination of the rate constant of a reaction.
2. Determination of the partition coefficient of a substance between two immiscible liquids.
3. Determination of surface tension and viscosity.
4. Thin layer chromatography.
5. Determination of chloride content in water.
6. Determination of cell constant and conductance of solutions.
7. Synthesis of a polymer drug
8. Determination of saponification / acid value of an oil.
9. Determination of redox potentials and emf by Potentiometric method.
10. Estimate the adsorption of acetic acid by charcoal.

Total: 30hours

Text Books:
T1 S. Sundaram and K. Raghavan "Practical Chemistry", S. Viswanathan Co. 3rd edition 2011.

T2 Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rd edition 2011.

Reference Book:
R1 Vogel's – "Textbook of qualitative organic Analysis", Longmann, 12th edition, 2011

R2 J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6th edition, 2010.

Web Links
1 https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802/kinetics/x2eef969c74e0d802/introduction-to-rate-laws/v/experimental-determination-of-rate-laws
2 https://www.youtube.com/watch?v=qimKGskCyh8
3 https://www.youtube.com/watch?v=7_6_dKb67k

COURSE OUTCOMES

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

CO1:	Estimate the rate constants of reactions and partition coefficient of immiscible Liquids.	K3
CO2:	Find the viscosity and to test the purity of the compound.	K5
CO3:	Estimate the amount of chlorine content present in drinking water and to know the conductance of a solution.	K5
CO4:	Develop a small drug molecule and to know the saponification of an oil.	K5
CO5:	Find out the unknown element by Potentiometric method and to remove some of the toxic chemical by charcoal method.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	1	3	1	-	-	-	-	-	-	-	-	-
CO2	-	1	1	2	1	-	-	-	-	-	-	1	-	
CO3	-	1	2	3	2	3	3	-	-	-	2	-	2	3
CO4	-	1	2	3	3	3	3	-	-	-	2	-	2	3
CO5	-	1	1	2	3	2	1	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
		✓	✓	✓	

22ESAU07	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:

- To design and develop C Programs for various applications

LIST OF EXPERIMENTS:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. Recursive functions
11. Pointers and structures
12. File operations

Total: 30 h

Text Books:

T1:E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill
T2:Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill

Reference Books:
R1:Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India
R2:YashavantKanethar, "Let Us C", BPB Publications
R3:Ashok N.Kamthane, "Computer Programming", Pearson Education (India)

Web Links:

WL https://www.edx.org/course/c-programming-getting-started

COURSE OUTCOMES

CO1:	Determine the advanced features of the C language	K5
CO2:	Develop the model data using primitive and structured types.	K5
CO3:	Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.	K4
CO4:	Develops the ability to analyze a problem, develop an algorithm to solve it.	K5
CO5:	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	1	3	1	-	-	-	-	-	-	-	-	-
CO2	-	1	1	2	1	-	-	-	-	-	-	-	1	-
CO3	-	1	2	3	2	2	3	-	-	-	2	-	2	2
CO4	-	1	2	3	3	2	3	-	-	-	2	-	2	2
CO5	-	1	1	2	3	2	1	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓	✓	

22MCAU02	UNIVERSAL HUMAN VALUES	L	T	P	Credits
		2	0	0	0

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education   6

Understanding the need, basic guidelines, content and process for Value Education. Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation-as the mechanism for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding. Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II Understanding Harmony in the Human Being - Harmony in Myself   6

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. 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. Programs to ensure Sanyam and Health.

UNIT III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship   6

Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family); Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!.

UNIT IV Understanding Harmony in the Nature and Existence - Whole existence as Co-existence   6

Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT V Implication of the above Holistic Understanding of Harmony on Professional Ethics   6

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identifythescopeandcharacteristicsofpeople-friendlyandeco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual as socially and ecologically responsible engineers, technologists and managers, b) At the level of society as mutually enriching institutions and organizations.

                                                                    Total 30hours

Text Books:

1. Dr. Ritu Soryan, "Universal Human Values and Professional Ethics", S.K. Kataria & Sons.

2. R.R. Gaur, R. Sangal and G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books.

Reference Books:

1. Dr. Sandhya Srivastava, "Universal Human Values & Professional Ethics" R. Narain & Co.

Web Links:

1. https://www.youtube.com/watch?v=P8age0P3Ogg&list=PLWDeKF97v9SO0bdgmpaghDMfjkoml eufx&index=4

2. https://www.youtube.com/watch?v=9rqRZ54ueoq4&list=PLWDeKF97v9SO8vvjC 1KygteziTbTjN1So&index=3

Course Outcomes:

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

CO1:	Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society	K3
CO2:	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body	K5
CO3:	Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society	K5

CO4:	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	K5
CO5:	Distinguish between ethical and unethical practices, and start working out the strategy to actualise a harmonious environment wherever they work.	K5

Text Books:

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

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO2	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO4	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO5	-	-	-	-	-	3	3	2	-	-	-	-	-	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓	✓	

22BSAU07	MATHEMATICS-III (Fourier Series and Transforms)	L	T	P	Credits
		3	1	0	4

Course Objective:
> To learn the concept of Fourier series and Transforms for various functions in the given interval.
> To Solve the boundary value problems using finite and infinite transforms.

UNIT I FOURIER SERIES   12

Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series- Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM   12

Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transform – Properties – Transform of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS   12

Formation of partial differential equations – singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   12

Classification PDE-Method of separation of variables – One dimensional wave equation and one dimensional heat equation of heat conduction – Steady state solution of two-dimensional heat equation of heat conduction (square plate only).

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS   12

Z-transform –Introduction- properties – Inverse Z-transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

Total Hours: 60Hours

TEXTBOOKS:
T1: Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi, 43rd Edition, 2013
T2: Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 6th reprint, 2008.
T3:   SivaramakrishnaDas P&Vijayakumari C,A Text book of EngineeringMathematics-III

REFERENCE BOOKS:
R1:   Bali N.P. and Manish Goyal "A Textbook of Engineering Mathematics', Laxmi Publications, 9th edition, 2011.
R2: Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 9th Edition, 2011.

R3: Glyn James, "Advanced Modern Engineering Mathematics", Pearson education, 3rd Edition, 2012.

Web Links:
1. https://nptel.ac.in/courses/111107098
2. https://nptel.ac.in/courses/111106046
3. https://nptel.ac.in/courses/111106111
4. https://www.youtube.com/watch?i=IkAvgVUvY-Y
5. https://www.youtube.com/watch?v=1JnayXHhjlg

COURSE OUTCOMES

CO1:	Develop Fourier series for different types of functions.	K3
CO2:	Analyze the transforms for various functions.	K4
CO3:	Identify the basic concepts of Partial differential equations for solving standard Partial differential equations	K3
CO4:	Analyze the heat flow problems used in various situations	K4
CO5:	Identify the applications of z-transforms and its properties for various functions.	K3

MAPPING OF PROGRAM OUTCOME TO COURSE OUTCOME:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	1	1	-	1	-	-
CO2	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO3	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO4	1	1	1	1	2	-	-	-	-	1	-	1	1	1
CO5	1	1	1	1	2	-	-	-	-	1	-	1	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓	✓	✓

22ESAU08	ELECTRICAL DRIVES AND CONTROL	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the basic concepts of different types of electrical machines and their performance

➤ To study the different methods of starting of motors and its characteristics.

UNIT I INTRODUCTION   9

Fundamentals of electric drives – advances of electric drive-characteristics of loads – different types of mechanical loads – choice of an electric drive – control circuit components: Fuses, switches, circuit breakers, contactors, Relay – control transformers.

UNIT II SPEED CONTROL OF DC MACHINES   9

DC shunt motors – Speed Torque characteristics - Ward Leonard method. DC series motor – series parallel control – solid state DC drives – Thyristor bridge rectifier circuits- chopper circuits.

UNIT III SPEED CONTROL OF AC MACHINES   9

Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control.

UNIT IV MOTOR STARTERS AND CONTROLLERS   9

DC motor starters using voltage sensing relays, current sensing relays and time delay relays – wound rotor induction motor starters – starters using frequency sensing relays - DOl –starter and auto transformer starter.

UNIT V HEATING AND POWER RATING OF DRIVE MOTORS   9

Load diagram, over load capacity, insulating materials, heating and cooling of motors, service condition of electric drive - continuous, intermittent and short time – industrial application.

TOTAL 45 HOURS

Text Book:

1. N.K De and P.K Sen 'Electric Drives' Prentice Hall of India Private Ltd, 2002

2. Vedam Subramaniam 'Electric Drives' Tata McGraw Hill, New Delhi, 2007

3. V.K Mehta and Rohit Mehta 'Principle of Electrical Engineering', S Chand & Company, 2008

Reference Book:

1. S.K Bhattacharya Brinjinder Singh 'Control of Electrical Machines' New Age International Publishers, 2002

2. John Bird 'Electrical Circuit theory and technology' Elsevier, First Indian Edition, 2006.

Weblinks:

- https://nptel.ac.in/course/108104140
- https://akeegh.com/degree-courses/electrical-engineering-drives-and-control

COURSE OUTCOMES

CO1:	Describe the electrical drives and components	K3
CO2:	To learn the general characteristics of different types of electrical AC & DC Motors with respect to the applications	K3
CO3:	To understand the operation of different types of DC electrical drives	K3
CO4:	To understand the operation of three Phase Induction Motors Drive	K3
CO5:	Analyze the performance of induction motor drives under different conditions	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	1	2	2							2	2	3
CO 2	2	1	1	1	1							2	2	3
CO 3	2	2	2	1	2							2	2	3
CO 4	1	2	1	2	1							2	2	3
CO 5	1	2	1	2	1							2	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓	✓	✓

22PCAU01	ENGINEERING THERMODYNAMICS	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To familiarize the students fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance

➤ Explain the concepts involved in engineering thermodynamics and apply the knowledge in applications oriented situations.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychometric Chart permitted)

UNIT I   BASIC CONCEPT AND FIRST LAW   12

Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work; Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipment's.

UNIT II   SECOND LAW AND ENTROPY   12

Second law of thermodynamics – Kelvin's and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, COP, Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

UNIT III THERMODYNAMIC AVAILABILITY   12

Basics – Energy in non-flow processes: Expressions for the Energy of a closed system- Equivalence between mechanical energy forms and Energy – Flow of energy associated with heat flow – Energy consumption and entropy generation. Energy in steady flow processes: Expressions for Energy in steady flow processes – Energy dissipation and entropy generation.

UNIT IV PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE   12

Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle.

UNIT V   PSYCHROMETRY   12

Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

TOTAL: 60 HOURS

Text Books:

1. Nag P K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 1998.

2. Lynn D Russell, George A, Adebiyi "Engineering Thermodynamics", Indian Edition, Oxford University Press, New Delhi, 2007.

Reference Books:

1. Yunus A engel and Michael Boles, Thermodynamics an Engineering Approach.

2. E.Ratha Krishnan, Fundamentals of Engineering Thermodynamics, 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.

3. Arora C P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

5. Veerwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987

6. Holman J.P., "Thermodynamics", 3rd Ed, McGraw-Hill, 1995.

Weblinks:

- https://onlinecourses.nptel.ac.in/noc20_ae09/preview
- https://web.mit.edu/16.unified/www/FALL/thermodynamics

COURSE OUTCOMES

CO1:	Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions	K3
CO2:	Apply second law of thermodynamics to open and closed systems and calculate entropy and availability	K3
CO3:	Apply Rankine cycle to steam power plant and compare few cycle improvement methods	K3
CO4:	Derive simple thermodynamic relations of ideal and real gases	K4
CO4:	Calculate the properties of gas mixtures and moist air and its use in psychometric processes	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	2	2	-	-	-	-	3	3	3	3	3	3
CO2	3	3	2	2	-	-	-	-	2	2	2	2	3	2
CO3	3	2	3	2	-	-	-	-	3	2	2	2	3	1
CO4	2	2	3	3	-	-	-	-	3	2	2	3	2	3
CO5	2	3	3	2	-	-	-	-	3	2	3	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓	✓	✓

22PCAU02	AUTOMOTIVE ENGINES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the basic principles of engines used for automobiles and different systems.

➤ To knowledge on automotive engines and along with its functions.

UNIT I CONSTRUCTION AND OPERATION   9

Constructional details of spark ignition (SI) and compression ignition (CI) engines. Working principles. Two stroke SI and CI engines – construction and working. Comparison of SI and CI engines and four stroke and two stroke engines. Engine classification, firing order. Otto, diesel and dual cycles.

UNIT II   FUEL SYSTEMS   9

Air fuel ratio requirement of SI engines. Air fuel ratio and emissions, working of a simple fixed venture carburetor, Constant vacuum carburetor. Diesel fuel injection systems-Jerk pumps, distributor pumps, pintle and multihole nozzles. Unit injector and common rail injection systems. Injection pump calibration. Need for a governor for diesel engines. Description of a simple diesel engine governor.

UNIT III COMBUSTION AND COMBUSTION CHAMBERS   9

Introduction to combustion in SI and diesel engines and stages of combustion. Dependence of ignition timing on load and speed. Knock in SI and CI engines. Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design.

UNIT IV SUPERCHARGING, TURBOCHARGING AND ENGINE TESTING   9

Supercharging and Turbocharging. Different methods of turbocharging. Intercooling. Turbocharger controls including waste gate, variable geometry, variable nozzle types. Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, Cylinder pressure measurement. Engine performance maps, Engine testing standards.

UNIT V COOLING AND LUBRICATION SYSTEMS   9

Ned for cooling, types of cooling systems- air and liquid cooling systems. Thermosyphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure fed, dry and wet sump system. Properties of lubricants.

TOTAL: 45 HOURS

Text Books:

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.
2. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.
3. G.B.S Narang "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi, 2005.

Reference Books:

1. Heisler, "Advanced Engine Technology" SAE Publication, 1995
2. Edward F. Obert "Internal Combustion Engines" 3 Edition, 1970

COURSE OUTCOMES

CO1:	Understand the construction and operation of engines	K3
CO2:	Acquire knowledge on the fuel systems in engines	K3
CO3:	Describe various types of fuel injection systems	K4
CO4:	Understand various types of combustion chamber in SI and CI engines	K3
CO5:	Familiar with supercharging, Turbo charging and Engine Testing	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	3	3	2	-	-	-	-	-	2	2	1	2
CO 2	3	3	2	2	1	-	-	-	-	-	2	2	3	3
CO 3	2	2	1	1	1	-	-	-	-	-	2	2	2	2
CO 4	3	1	3	2	2	-	-	-	-	-	3	2	2	3
CO 5	2	2	1	1	2	-	-	-	-	-	1	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓		✓

22PCAU03	FLUID MECHANICS AND MACHINERY	L	T	P	Credits
		3	0	2	4

Course Objective:
- To understand the importance of various types of flow in pumps and turbines
- To understand the importance of dimensional analysis

UNIT I INTRODUCTION 9

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 9

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equation. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Dimension and units. Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Navier-Stokes equations Introduction of dimensionless parameters. Application of dimensionless parameters.

UNIT IV ROTO DYNAMIC MACHINES 9

Homologous units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler's equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

UNIT V POSITIVE DISPLACEMENT MACHINES 9

Reciprocating pumps: Single acting, double acting-advantages and disadvantages. Indicator diagrams. air vessels-Work saved by air vessels. Rotary pumps. Classification. Working principle and performance curves.

TOTAL: 45 HOURS

Text Books:
1. Streeter, V. L. and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

References Books:
1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.)Eurasia Publishing House (P) Ltd, New Delhi, 1995.
3. Bansal. R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.

Weblinks:
- https://onlinecourses.nptel.ac.in/noc19_me55/preview
- https://nptel.ac.in/courses/112105206

COURSE OUTCOMES

CO1:	Familiar with the properties of fluids	K4
CO2:	Acquire the skill on flow through circular conduits	K3
CO3:	Attain the knowledge on dimensional analysis	K3
CO4:	Describe the roto-dynamic machines	K4
CO5:	Attain the knowledge on positive displacement machines	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO2	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO3	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO4	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO5	2	2	2	2	2	-	-	-	1	1	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓				✓

22PCAU04	AUTOMOTIVE ENGINE COMPONENTS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:

- To train the students to know the details of different engine components, dismantling and assembling them.
- To gain knowledge on the standards of measurements and calibration.

LIST OF EXPERIMENTS

1. Dismantling of 4-cylinder petrol engine.
2. Assembling of 4-cylinder petrol engine.
3. Dismantling of 6-cylinder diesel engine.
4. Assembling of 6-cylinder diesel engine.
5. Study of oil filter, fuel filter, fuel injection system, carburetor, MPFI
6. Study of ignition system components – coil, magneto and electronic ignition systems.
7. Study of engine cooling system components
8. Study of engine lubrication system components
9. Ovality and taper measurement of cylinder bore and comparison with standard specifications
10. Ovality and taper measurement of engine crank shaft and comparison with standard specification

LIST OF EQUIPMENTS - Each 1 No

1. Four-cylinder petrol engine
2. Six-cylinder diesel engine
3. Fuel filter, fuel injection pump, injector, carburetor, MPFI component
4. Ignition coil, magneto, electronic ignition system components
5. Water pump, thermostat, radiator, temperature gauge
6. Lub. oil pump, pressure relief valve, filter, oil pressure gauge
7. Internal micrometer, external micrometer, dial gauges

TOTAL: 45 HOURS

Text Books:

1. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.
2. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi,2005.

Reference Book:

1. Heisler, "Advanced Engine Technology" SAE Publication, 1995
2. Edward F. Obert "Internal Combustion Engines" 3 Edition, 1970

Weblinks:

- https://onlinecourses.nptel.ac.in/noc22_de02/preview
- https://www.digimat.in/nptel/courses/video/107106088/L01.html

COURSE OUTCOMES

CO1:	Demonstrate the Dismantling and Assembling of 4–cylinder petrol engine	K3
CO2:	Demonstrate the Dismantling and Assembling of 6–cylinder diesel engine	K3
CO3:	Describe the oil filter, fuel filter, fuel injection system, carburetor, MPFI	K3
CO4:	Explain the ignition system components – coil, magneto and electronic ignition systems	K3
CO5:	Describe the engine cooling system components	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	2	2	2							1	2	1
CO 2	2	1	1	2	1							1	2	1
CO 3	2	2	1	1	2							1	2	1
CO 4	1	2	1	2	1							1	2	1
CO 5	2	2	1	2	1							1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam:	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓	✓	

22PCAU05	ELECTRONICS AND MICROPROCESSORS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:
- To supplement the theoretical knowledge with practical use of electronic components and programming and control using micro-processors.
- Learn the design aspects of VI Characteristics diode.

LIST OF EXPERIMENTS

ELECTRONICS   30
1. VI Characteristics of PN Junction Diode
2. VI Characteristics of Zener Diode
3. Characteristics of CE Transistor
4. Characteristics of JFET
5. Characteristics of Uni Junction Transistor
6. RC or Wein Bridge Oscillator
7. Study of Logic Gates (Basic Gates)
8. Half Adder and Full Adder
9. Shift Registers and Counters
10. Operational Amplifier (Adder, Subtractor, Differentiator, Integrator, Inverting and Non - Inverting

MICROPROCESSOR   15
1. Block Transfer
2. 8 bit Addition, Subtraction
3. Multiplication and Division
4. Maximum and minimum of block of data
5. Sorting
6. Stepper Motor Interfacing

                                        TOTAL: 45 HOURS

LIST OF EQUIPMENTS

1. Voltmeters	5 No.
2. Ammeters	5 No.
3. PN Diode, BJT, JFET, Logic Gates, Shift Registers and Counters	1 set
4. Digital Logic Trainer Kits	1 No.
5. Breadboards	1 No.
6. Microprocessor Kits – 8085	5 No.
7. D/A Converter Interface	1 No.
8. Stepper Motor Interface	1 No.
9. CRO	1 No.
10. Waveform Generator	1 No.
11. Multimeter	1 No.

Text Books:

1. Sunil Mathur, Jeebananda Panda , Microprocessors and Microcontrollers, Prentice Hall India Pvt., Limited

2. Dr. Deepali A. Godse, Atul P. Godse , Digital Electronics and Introduction to Microprocessors and Microcontrollers, UNICORN Publishing Group

Reference Books:

1. A.K Chhabra, Fundamental of Digital Electronics And Microprocessors, S. Chand Limited

2. Noel Malcolm Morris, Microelectronic and Microprocessor-based System, Macmillan

Weblinks:

- https://nptel.ac.in/courses/108107029
- https://onlinecourses.swayam2.ac.in/cec21_cs16/preview

COURSE OUTCOMES

CO1:	Describe the characteristics of PN Junction Diode and Zener Diode	K4
CO2:	Describe the characteristics of CE Transistor, JFET and Uni Junction Transistor	K4
CO3:	Explain the RC Wein Bridge Oscillator and Logic Gates	K3
CO4:	Explain the Half Adder and Full Adder	K3
CO5:	Define Shift Registers, Counters and Operational Amplifier	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PSO1	PSO2
CO1	2	2	-	1	3	-	-	-	-	1	-	-	2	1
CO2	3	1	-	2	3	-	-	-	-	1	-	-	2	-
CO3	2	2	-	2	3	-	-	-	-	1	-	-	3	-
CO4	3	3	-	2	3	-	-	-	-	2	-	-	3	2
CO5	3	3	1	3	3	-	1	-	-	2	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Observation	Record
	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
		✓		✓	

22MCAU03	BASIC LIFE SKILLS	L	T	P	Credits
		2	0	0	0

COURSE OBJECTIVE:

- To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I PHYSICAL HEALTH
6

Manavalakalai (SKY) Yoga Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment Simplified Physical Exercises; Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits Yogasanas; Pranamasana – Hastha Uttanasana – Pada Hasthasana – AswaSanjalana Asana – Thuvipathaasva Sanjalana asana – Astanga Namaskara – Bhujangasana–Atha Mukha Savasana – Aswa Sanjalana Asana – Pada Hasthasana–Hastha Uttanasana – Pranamasana.Pranayama: Naddisuddi - Clearance Practice - Benefits.

UNIT II LIFE FORCE
6

Reasons for Diseases – Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds) Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness; Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid. Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III MENTAL HEALTH
6

Mental Frequencies - Beta, Alpha, Theta and Delta wave - Agna Meditation explanation - benefits. Shanthi Meditation explanation – Benefits - Thurya Meditation explanation – Benefits. Benefits of Blessing - Self blessing (Auto suggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV VALUES
6

Human Values: Self-control - Self-confidence - Honesty Contentment - Humility – Modesty Tolerance - Adjustment - Sacrifice – Forgiveness Purity (Body, Dress, Environment) - Physical purity - Mental purity – Spiritual purity Social Values: Non-violence– Service Patriotism – Equality Respect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V MORALITY (VIRTUES)
6

Importance of Introspection - I - Mine (Ego, Possessiveness) Six Evil Temperaments - Greed - Anger – Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness) Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

TOTAL: 30hours

TEXT BOOKS:

1. Vethathiri Maharishi, 16th Edi 2013, Yoga for Modern Age, Vethathiri Publications, Erode.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Vethathiri Publications, Erode.
3. Vethathiri Maharishi, 3rd Edi 2014, Kayakalpam, Vethathiri Publications, Erode.
4. Rev.Dr.G.U. Pope, 2016, Thirukkural, Giri Trading Agency.

5. Vethathiri Maharishi, 1994, Mind, Vethathiri Publications, Erode
6. Iyengar, B.K.S. 2008, Light on Yoga, Noida, UP India, Harper Collins Publishing India Ltd.,

REFERENCE BOOKS:

7. K. R. Dhanalakshmi and N. S. Raghunathan, "Personality Enrichment, Margham Publications
8. Dr V. M. Selvaraj, "Personality Development" Bhavani Publications
9. R. S. Agarwal, "Quantitative Aptitude".
10. A.K Gupta, "Logical and Analytical Reasoning (English)", 30th Edition.

Web link:

1. https://www.mindinthemaking.org/life-skills

COURSE OUTCOMES:

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

CO1:	Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.	K3
CO2:	Demonstrate foundational standing, sitting, balance postures with proper alignment and Maintain youthfulness through kaya kalpa practice	K5
CO3:	Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them	K5
CO4:	Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values.	K5
CO5:	Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense of relaxation through meditation to keep up morality in life.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO2	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO3	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO4	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO5	-	-	-	-	-	3	3	3	3	-	-	3	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
			✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓		

22BSAU08	MATHEMATICS-IV	L	T	P	Credits
	(Statistical and Numerical Methods)	3	1	0	4

COURSE OBJECTIVE:

➢ Provides the necessary basic concepts of a few Statistical and Numerical methods
➢ Familiarize the procedures for solving numerically different kinds of problems occurring in engineering

UNIT I TESTING OF HYPOTHESIS   14

Sampling distributions –Introduction to Large samples and Small samples – Tests for single mean, two mean and paired t-test – F-test – Chi-square test for goodness of fit – Independence of attributes- ANOVA – One-way classification – Two way classification.

UNIT II CORRELATION AND REGRESSION ANALYSIS   10

Introduction to Correlation Analysis – Karl Pearson's Coefficient of Correlation – Rank Correlation-Regression Analysis – Curve fitting – Introduction – Method of least squares.

UNIT III SOLUTION OF EQUATIONS   14

Introduction –Newton-Raphson's method – Regula falsi method – Gauss Elimination method –Gauss-Jordan methods –Matrix Inversion by Gauss-Jordan method.

UNIT IVINTERPOLATION, NUMERICAL DIFFERENTIATION ANDNUMERICAL
INTEGRATION   10

Introduction–Newton's forward and backward interpolation–Lagrange's Interpolation formula-Derivatives using Newton's forward and backward difference formula– Numerical integration using Trapezoidal ,Simpson's 1/3 rules and Simpson's 3/8 rules.

UNITV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

                                                                  12

Introduction-Taylor's series method – Euler's method - Modified Euler's method –Second and Fourth order Runge-Kutta method for solving first order equations – Milne's Predictor corrector method (Simple problems).

                                                  Total Hours: 60

TEXT BOOKS:

T1: Grewal, B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna

Publishers, New Delhi, 2012.

T2: Johnson R.A. and Gupta C.B, "Miller and Freund's Probability and Statistics for Engineers",

Pearson Education, Asia, 7th edition, 2007.

T3: Dr.Kandasamy ,P,Dr.Thilagavathi,Dr.Gunavathi K,"Statistics and Numerical methods",S. Chand and Company,first edition,2010.

REFERENCE BOOKS:

R1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 7th Edition, 2014.

R2. Walpole R.E, Myers R.H, Myers S.L, and Ye, K, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition, 2011.

WEBLINK:

1. https://nptel.ac.in/courses/111105077
2. https://www.academia.edu/35702788/2_Numerical_and_Statistical_pdf
3. https://onlinecourses-archive.nptel.ac.in/noc18_ma11/preview

COURSE OUTCOMES:

CO1:	Utilize the skill on testing of hypothesis & ANOVA.	K3
CO2:	Apply the concept of Statistical measures like Correlation and Regression.	K2
CO3:	Evaluate the knowledge on solution of equations and eigen value problems.	K5
CO4:	Describe the applications of interpolation, numerical differentiation and numerical integration.	K4
CO5:	Establish the numerical solution of ordinary differential equations.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	2	2	2	-	-	-	-	-	3	-	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	2	2	-	-	-	-	-	3	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		

22PCAU06	ENGINEERING METALLURGY	L	T	P	Credits
		3	0	0	3

Course Objective:

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.
- To understanding of basic structure and crystal arrangement of materials, the phase diagrams, advantages of heat treatment.

UNIT I ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solution, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys. Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes) - Engineering Ceramics Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON –Composites-Classifications-Metal Matrix and FRP - Applications of Composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 HOURS

Text Books:
1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company 1997.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014.

Reference Books:
1. Kenneth G Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.

2. Raghavan V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 2015.
3. U.C Jindal Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Darling Kindersley, 2012
4. Upadhyay G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

Weblinks:

- https://onlinecourses.nptel.ac.in/noc20_mm09/preview
- https://nptel.ac.in/courses/113102080

COURSE OUTCOMES

CO1:	Explain alloys and phase diagram, Iron-Iron carbide diagram and steel classification	K3
CO2:	Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes	K3
CO3:	Summarize the mechanism of plastic deformation and testing mechanical properties	K5
CO4:	Clarify the effect of alloying elements on ferrous and non-ferrous metals	K4
CO5:	Differentiate different non-metallic materials	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO–	PO 1	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
CO 1	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	1	1	3	2	-	-	-	-	-	-	-	2	1
CO 3	1	2	2	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	1	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	1	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU07	AUTOMOTIVE FUELS AND LUBRICANTS	L	T	P	Credits
		3	0	0	3

Course Objective:
- To understand the properties of fuels and lubricants for the design and operation of the I.C engines.
- To elaborate the properties of fuels used in IC engines.

UNIT I MANUFACTURE OF FUELS AND LUBRICANTS 9

Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

UNIT II THEORY OF LUBRICATION 9

Engine friction introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system.

UNIT III LUBRICANTS 9

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease.

UNIT IV PROPERTIES AND TESTING OF FUELS 9

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc.

UNIT V COMBUSTION & FUEL RATING 9

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating, fuel requirements. Additive - mechanism, requirements of an additive, petrol fuel additives and diesel fuel additives – specifications of fuels.

TOTAL : 45 HOURS

Text Books:
1. Ganesan. V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. Mathur. M.L., Sharma. R.P "A course in internal combustion engines", Dhanpatrai publication, 2003.
3. Obert. E.F "Internal Combustion Engineering and Air Pollution", International book Co., 1988.

Reference Books:
1. Brame J.S.S. and King. J.G – "Fuels Solids, Liquids, Gaseous". Edward Arnold, 1967
2. Francis. W. "Fuels and Fuel Technology", Vol. I & II, Pergamon, 1965
3. Hobson. G.D. & Pohl. W "Modern Petroleum Technology", 1974

4. Lansdown, A.R., Lubrication, "A practical guide to lubricant selection", Pergamon press, 1982.
5. Raymond C. Gunther, "Lubrication", Chilton Book Co., 1971.

Weblinks:

- https://nptel.ac.in/courses/107106088
- https://www.iitm.ac.in/automotive-fuel-and-lubricant-application/

COURSE OUTCOMES

CO1:	Explain the distillation process, additives for fuels and characteristics of fuels	K3
CO2:	Discuss the need and performance characteristics of alternative liquid fuels for both SI and CI engines	K3
CO3:	Describe the need and performance characteristics of alternative gaseous fuels for both SI and CI engines	K4
CO4:	Calculate and analyse A/F ratio for the engine operating conditions and also can estimate quantitatively the exhaust gas constituents	K5
CO5:	Explain the need for lubricants, factors influencing the engine lubrication and testing of fuels	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 2	1	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 3	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 4	1	1	2	1	2	-	-	-	-	-	-	-	2	1
CO 5	1	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU08	AUTOMOTIVE CHASSIS	L	T	P	Credits
		3	0	0	3

Course Objective:
- Study of the Constructional details and Theory of important drive lines.
- Familiar in components of automotive chassis systems of automobiles.

UNIT I LAYOUT, FRAME, FRONT AXLE AND STEERING SYSTEM   9

Basic construction of chassis, Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Types of Front Axles and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion, Ackerman's and Davi's Steering Mechanisms, Steering Linkages, Different Types of Steering Gear boxes, Slip Angle, Over-Steer and Under-Steer, Reversible and Irreversible Steering, Power Steering.

UNIT II DRIVE LINE, FINAL DRIVE AND DIFFERENTIAL   9

Driving Thrust and its effects, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Final drive, different types of final drive, Worm and Worm wheel, straight bevel gear, spiral bevel gear and hypoid gear final drive, Differential principle, Constructional details of differential unit, Differential housings, and Non-Slip differential, differential locks.

UNIT III REAR AXLES, WHEELS, RIMS AND TYRES   9

Construction of rear axles, Types of Loads acting on rear axles, Full –Floating, Three-Quarter Floating and Semi-Floating Axle, Twist beam rear axle, Types, Multi axle vehicles, Wheels and Rims, Types of Tyres and their constructional details.

UNIT IV BRAKE SYSTEMS   9

Need for Brake systems, Stopping Distance, Time and Braking Efficiency, Effect of Weight Transfer during Braking, Classification of brakes , Braking Torque, drum brake and disc Brake Theory, Types and Construction of Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power-Assisted Braking System, Servo Brakes, Retarders – antilock braking systems(ABS).

UNIT V SUSPENSION SYSTEM   9

Requirement of Suspension System, Types of Suspension Springs, Constructional details and characteristics of Single Leaf, Multi-Leaf spring, Coil and Torsion bar Springs, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Independent Suspension System, Shock Absorbers, Types and Constructional details of Leaf and Coil Springs.

                                                                    TOTAL: 45 HOURS

Text Books:
1. K. Newton, W. Steeds and T.K. Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004
2. P.M. Heldt, "Automotive Chassis", Chilton Co., New York, 1992.
3. W. Steel, "Mechanics of Road Vehicles", Iliffe Books Ltd., London, 1992.

Reference Books:
1. Harban Singh Reyat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.

2. G.J.Giles, "Steering Suspension and Tyres", Iliffe Books Ltd, London, 1975.
3. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.
4. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi, 2005.
5. R.P.Sharma, "Automobile Engineering", DhanpatRai& Sons, New Delhi, 2000.

Weblinks:

- https://nptel.ac.in/courses/107106088
- https://www.myigeit.com/Library/CourseDetails=9866?catID=11&name=3CX_3_Automotive _Chassis_Training_Training_Course

COURSE OUTCOMES

CO1:	Clearly explain the vehicle layout and drives	K2
CO2:	Understand the steering system and its components	K2
CO3:	Familiar with the driveline system components and its working	K4
CO4:	Explain the concept of various types of braking system and its components	K2
CO5:	Clearly understand suspension systems and its components	K2

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PSO1	PSO1
CO 1	1	2	1	1	2	-	-	-	-	-	-	-	1	2
CO 2	1	1	2	2	1	-	-	-	-	-	-	-	1	1
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	1	1	2	2	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU09	HEAT AND MASS TRANSFER	L	T	P	Credits
		3	0	2	4

Course Objective:
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic.
- To understand the concepts of heat transfer through extended surfaces.
  (Use of standard HMT data book permitted)

UNIT I CONDUCTION 12

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differential equation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems – Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT II CONVECTION 12

Basic Concepts – Convective Heat Transfer Coefficient – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plate, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselt theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNIT IV RADIATION 12

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoff Law –Black Body Radiation – Grey body radiation Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation.

UNIT V MASS TRANSFER 12

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL: 60 HOURS

Text Books:
1. Sachdeva R. C. "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 1995.
2. Yadav R. "Heat and Mass Transfer" Central Publishing House, 1995.

Reference Books:
1. Nag P.K. " Heat Transfer", Tata McGraw-Hill, New Delhi, 2002.
2. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.

3. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 1998

4. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 1998.

5. Vebraj R, "Heat & Mass Transfer", Ane Books, New Delhi, 2004

Weblinks:
- https://nptel.ac.in/courses/112101097
- https://onlinecourses.nptel.ac.in/noc19_ch23/preview

COURSE OUTCOMES

CO1:	Ability to design and analyze the performance of heat exchangers	K4
CO2:	Describe the physical phenomena associated with convection	K4
CO3:	Analyze external and internal, forced and free convection problems	K4
CO4:	Explain the physical mechanisms involved in radiation heat transfer	K3
CO5:	Analyze the radiative heat exchange between surfaces and in diffuse, gray enclosures.	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	2	3	1								3	2
CO 2	1	1	1	2	2								1	1
CO 3	2	2	2	3	3								2	2
CO 4	1	1	1	2	2								3	1
CO 5	2	2	1	3	2								2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU10	AUTOMOTIVE CHASSIS COMPONENTS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:

➢ To train the students to know the details of different chassis components, dismantling and assembling them

➢ To develop the practical knowledge in the field of Automobile engineering

LIST OF EXPERIMENTS

Study and measurement of the following chassis frames:

1. Heavy duty vehicle frame (Leyland, Tata etc)
2. Light duty vehicle frame (Ambassador, Maruti van etc)
3. Front Axle
4. Rear Axle
5. Differential
6. Steering systems along with any two types of steering gear box
7. Braking systems – hydraulic servo vacuum, compressed air power brake.
8. Leaf spring, coil spring, torsion bar spring, Hydraulic shock absorber
9. Clutch assembly of different types
10. Gear Box
11. Transfer case

THE LIST OF EQUIPMENTS - Each 1 No (For A Batch of 30 Students)

1. Heavy duty vehicle chassis frame (Leyland or Tata)
2. Light duty vehicle chassis frame
3. Front axle
4. Rear axle
5. Steering system
2. Steering gear box (Rack and pinion, recirculating Ball type)
3. Hydraulic brake system
4. Air brake system
5. Leaf spring, coil spring, torsion bar
6. Hydraulic shock absorber
7. Diaphragm clutch assembly
8. Gear box (light duty, heavy duty)
9. Transfer case

TOTAL= 45 HOURS

Text Books:

1. K. Newton, W. Steeds and T.K. Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.
2. P.M. Heldt, "Automotive Chassis", Chilton Co., New York, 1982.

Reference Books:

1. Harban Singh Reyat, "The Automobile", S. Chand & Co. Ltd, New Delhi, 2000.
2. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.

COURSE OUTCOMES

CO1:	Describe the Heavy duty vehicle frame	K3
CO2:	Describe the Light duty vehicle frame	K3
CO3:	Demonstrate the dismantling and assembling of Front Axle, Rear Axle and Differential	K3
CO4:	Define the Steering systems along with any two types of steering gear box	K3
CO5:	Explain the Braking systems – hydraulic servo vacuum, compressed air power brakes	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	3	-	-	-	-	1	-	-	3	1
CO2	3	1	-	2	3	-	-	-	-	1	-	-	2	-
CO3	2	2	-	2	3	-	-	-	-	1	-	-	3	-
CO4	3	3	-	2	3	-	-	-	-	2	-	-	3	2
CO5	3	3	1	3	3	-	1	-	-	2	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22PCAU11	STRENGTH OF MATERIALS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:
➤ To study the mechanical properties of materials when subjected to different types of loading

STRENGTH OF MATERIALS (30Hrs)

LIST OF EXPERIMENTS (Any Five of the following)
1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals – Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No	NAME OF THE EQUIPMENT	Qty
1	Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1

Text Books:

1. R.K. Rajput, Strength of Materials, S. Chand Publishing

2. Ramamrutham S., Strength of Materials, Dhanpat Rai Publishing Company (p) Ltd

Reference Book:

1. R.K. Bansal, A Textbook of Strength of Materials, Laxmi Publications

Weblinks:
- https://onlinecourses.nptel.ac.in/noc20_ce34/preview
- https://nptel.ac.in/courses/112107146

COURSE OUTCOMES

CO1:	Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials	K3
CO2:	Evaluate the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test	K4
CO3:	Conduct the torsion test to determine the modulus of rigidity of given specimen	K3
CO4:	Examine the stiffness of the open coil and closed coil spring and grade them	K4
CO5:	Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	3	-	-	-	-	1	-	-	2	1
CO2	3	1	-	2	3	-	-	-	-	1	-	-	2	-
CO3	2	2	-	2	3	-	-	-	-	1	-	-	3	-
CO4	3	3	-	2	3	-	-	-	-	2	-	-	3	2
CO5	2	3	1	2	2	-	1	-	-	2	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓	✓	

22BSAU09	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	Credits
		3	0	0	3

Course Objectives:

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future

- To provide understanding of component of environment, their function ,quality, issues related to environment ,effect of quality degradation on human beings and their solutions

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY   9

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Bio-geographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – 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 Field Study of Common Plants, Insects and Birds. Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION   9

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management - Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES   9

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction – Mining – Dams and their ground water – Floods – Drought – Conflicts over 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, Change caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources - Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People: its Problems and Concerns, Case Studies Role of non – governmental organisation – Environmental Ethics- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL: 45 HOURS

Text Book:
1. Gilbert M.Master, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw- Hill.NewDelhi, (2006).

Reference Books
1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ, House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

Web Links:
1. https://onlinecourses.nptel.ac.in/noc20_ge16/preview
2. https://ggn.dronacharya.info/AP5Dept/Downloads/QuestionBank/ENVIRONMENTAL-STUDIES_NPTEL-Link.pdf
3. http://esgri.org/esgri50/ENVS302/pdf/lec14.pdf
4. https://onlinecourses.nptel.ac.in/noc19_ge22/preview

COURSE OUTCOMES

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

CO1:	Understand the core concepts, methods of ecological and physical sciences, their application in environmental problem-solving	K3
CO2:	Apply system concepts and methodologies to analyse, understand the interactions between social and environmental processes.	K5

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CO3:	Apply the ethical, cross-cultural, and historical content of environmental issues and the link between human and natural systems.	K5
CO4:	Develop the understanding based on the observations and illustration, drawn from the experiences of physical, biological, social and cultural aspects of life rather than abstractions.	K5
CO5:	Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	-	-	-	-	-	1	1	1	-	1	1	1
CO2	1	1	-	-	-	-	-	1	1	-	-	-	1	1
CO3	-	1	-	-	-	-	-	2	-	1	-	1	-	1
CO4	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO5	1	-	-	1	-	-	-	2	1	1	-	1	1	-

ASSESSMENT METHODS: S

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignment	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓		

22MCAU04	GENDER INSTITUTION AND SOCIETY	L	T	P	Credits
		2	0	0	0

Course Objective:

The course helps the student to understand concepts of social justice and gender justice. It provides the student with the knowledge of various institutions functioning worldwide which aim to eradicate discrimination against women. The course further aids students in understanding feminism and gender in relation to the society and to study the basic constitutional remedies available to women.

UNIT – I   06

Social Justice and Gender Justice – Theories relating to Social Justice – Theories relating to Gender Justice – Interrelationship between Gender justice and Social Justice

UNIT – II   06

International Conventions for protection of Women – Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) – National Commission for women – Constitutional remedies available for women under Indian Constitution.

UNIT – III   06

United Nations Entity for Gender Equality and the Empowerment of Women (UN Women) - Association for Women's Rights in Development (AWID) –Women kind worldwide – Centre for reproductive rights – Women's Environment and Development Organization (WEDO) - Global Fund for Women

UNIT – IV   06

International Center for Research on Women (ICRW) - European Institute for Gender Equality (EIGE) – Promundo - International Alliance of Women (IAW) - International Women's Development Agency (IWDA)

UNIT – V   06

World Health organisation – Sex and Gender – Feminism – Theories relating to Feminism – Gender and society

                                                                       Total 30hours

Text Books:
1. Law relating to Women and children, Mamta Rao
2. Gender, Politics and Institutions: Towards a Feminist Institutionalism, by Mona Lena krook and Fiona Mackay,2010
3. Gender Justice and Feminist Jurisprudence, Dr Sheetal Kanwal,2015
4. Narain's Gender and society, P Jain

Reference Books:
1. Gender Justice and feminist Jurisprudence by Dr Ishitha Chatterjee

2. Gender and Institutions, Moira Gatens and Alison Markkinson

Suggested Readings:
1. Women and Gender : Society and Community , Siddhartha Sarkar

Web link:
1. https: data.oecd.org inequality social-institutions-and-gender.htm

COURSE OUTCOMES:

CO1:	Understand the Concept of Social Justice and Gender Justice	K3
CO2:	Learning the International Conventions and constitutional remedies available for women.	K5
CO3:	Identify the various gender Institutions and its functions for development of women.	K5
CO4:	Assessing the International agencies.	K5
CO5:	Summarizing the study on feminism and relation of gender and society	K5

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	1	-	1	-	1	1	-	1	2	-
CO2	2	2	1	1	1	-	-	-	1	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	1	-	-	1	-	-	-	-	-	-	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

22PCAU12	AUTOMOTIVE TRANSMISSION	L	T	P	Credit
		3	0	0	3

Course Objective:
> To impart knowledge in hydrodynamic devices and hydrostatic devices.
> To understand the concept of automotive transmission components and its applications.

UNIT I CLUTCH AND GEAR BOX 9

Requirement of Transmission system. Different types of clutches: Principle, construction and operation of friction clutches. Objective of the gear box. Problems on performance of automobile such as Resistance to motion, Tractive effort, Engine speed & power and acceleration. Determination of gear box ratios for different vehicle applications. Different types of gear boxes.

UNIT II HYDRODYNAMIC DRIVES 9

Principles, performance and limitations of fluid coupling Constructional details of a typical fluid coupling. Reduction of drag torque. Principle, construction and advantages of hydrodynamic torque converters. Performance characteristics, converter couplings. Multi-stage Torque converter and poly phase torque converter.

UNIT III AUTOMATIC TRANSMISSION 9

Automatic transmission, relative merits and demerits when compared to conventional transmission, automatic control of gears, study of typical automatic transmission, Ford—T-model gearbox, Wilson gearbox, Electro-magnetic transmission, Automatic overdrive, Hydraulic control system for automatic transmission.

UNIT IV HYDROSTATIC DRIVE AND ELECTRIC DRIVE 9

Principle of hydrostatic drive systems. Construction and working of typical drives. Advantages and limitations. Control of hydrostatic transmission. Principle of electric drive. Early and modified Ward Leonard control systems.

UNIT V AUTOMATIC TRANSMISSION APPLICATIONS 9

Chevrolet "Turbo glide" transmission. Toyota's Automatic transmission with Electronic control system. Automatic Transmission with Intelligent Electronic controls system. Hydraulic Actuation system. Continuously Variable Transmission (CVT) – types – Operations.

TOTAL: 45 HOURS

Text Book:
1. Heldt P.M, Torque Converters, Chilton Book Co., 1992.
2. K. Newton, W Steeds and T.K Garret, "The Motor Vehicle", 13th Edition, Butterworth Heinemann, India, 2004.

Reference Book:
1. Harald Naunheimer, Bernd Bertsche, Joachim Ryborz, Wolfgang Novak, "Automotive Transmissions: Fundamentals, Selection, Design and Application", 2nd ed., Springer, 2011.
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002
3. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005.

COURSE OUTCOMES:

CO1:	Describe the concept of gear motions, drive line positions	K3
CO2:	Study about different types of gearboxes	K3
CO3:	Describe the multi stage and polyphase torque converters, performance characteristics	K3
CO4:	Study about Automatic transmission	K3
CO5:	Explain the working of various parts like engine, transmission, clutch, brakes	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	2	2								1	1
CO 2	1	2	1	1	1								1	2
CO 3	1	2	1	1	1								2	1
CO 4	1	1	2	2	1								1	1
CO 5	1	2	1	1	2								1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓		✓		✓

22PCAU13	VEHICLE DESIGN DATA CHARACTERISTICS	L	T	P	Credits
		3	1	0	4

Course Objective

➢ To understand the concepts of designing the vehicle and various resistances.
➢ To familiarize with vehicle and engine performance curves.

UNIT I   INTRODUCTION   12

Assumptions to be made in designing a vehicle, Range of values for Gross Vehicle Weight, Frontal Area, minimum speed, maximum acceleration, grad ability of vehicle in different gears, Basics of Automobile Design

UNIT II   RESISTANCE TO VECHICLE MOTION   12

Calculation, Tabulation and Plotting of Curves for Air and Rolling Resistances at various vehicle speeds, Calculation and Plotting of Driving force, Power requirement for different loads and acceleration, Maximum Power calculation.

UNIT III   PERFORMANCE CURVES-I   12

Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds, Interpolation of Pressure – Volume diagram, Calculation of frictional Mean Effective Pressure, Calculation of Engine Cubic Capacity, Bore and Stroke Length.

UNIT IV   PERFORMANCE CURVES-II   12

Connecting rod length to Crank Radius Ratio, Plotting of Piston Velocity and Acceleration against Crank Angle, Plotting Gas force, inertia force and Resultant force against Crank Angle, Turning Moment and Side Thrust against Crank Angle.

UNIT V   GEAR RATIOS   12

Determination of Gear Ratios for first, second, third and top gears, Acceleration and Grad ability vehicle, typical problems occur on Vehicle performance.

TOTAL: 60 HOURS

Text Book:
1 N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005
2. Heldt, P.M., High Speed Combustion Engines, Oxfore and I.B.H. Publishing Co. Kolkata, 2002.

Reference Books:

1. Heinz Heisler, Advanced Vehicle Technology, Butterworth-Heinemann Ltd. 2nd revised edition edition, 2002.
2. R.B.Gupta, Automobile Engineering, Satya Prakashan, New Delhi, 2012.

Weblinks:
- https://fdocuments.in/reader/full/lecture-notes-vehicle-design-and-data-characteristics
- https://nptel.ac.in/courses/107106080

COURSE OUTCOMES

CO1:	Describe the concepts and assumptions to be made in designing a vehicle	K3
CO2:	Interpret the various data for designing the vehicle	K4
CO3:	Identify the various resistances to vehicle motion and plot the graphs	K3
CO4:	Formulate the engine performance parameters and draw the performance curves	K4
CO5:	Evaluate the various forces and moments and plot the graphs	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO =	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	2	3	1								2	2
CO 2	1	1	1	2	1								1	1
CO 3	2	2	2	1	2								2	2
CO 4	1	1	1	2	2								1	1
CO 5	1	1	2	2	3								1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU14	MANUFACTURING PROCESS OF AUTOMOTIVE COMPONENTS	L	T	P	Credits
		3	0	2	4

Course Objective:

> This course provides required knowledge, skills and creates self confidence in students so that they can work on shop floor independently for accurate and precise measurements and manufacturing

UNIT I   POWDER METALLURGY   5

Process flow chart – Production of metal powders and their raw materials – Manufacture of friction lining materials for clutches and brakes – Testing and inspection of PM parts.

UNIT II   FORMING PROCESS   15

Forging – process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles. Extrusions: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Hydro forming Process, hydro forming of manifold and comparison with conventional methods – Hydro forming of tail lamp housing. Stretch forming – Process, stretch forming of auto body panels – Super plastic alloys for auto body panels.

UNIT III CASTING AND MACHINING   12

Sand casting of cylinder block and liners – Centrifugal casting of flywheel, piston rings, bearing bushes and liners, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Machining of connecting rods – crank shafts – cam shafts – pistons – piston pins – piston rings – valves – front and rear axle housings – flywheel – Honing of cylinder bores – copy turning and profile grinding machines.

UNIT IV   GEAR MANUFACTURING   5

Gear milling, Hobbing and shaping – Gear finishing and inspection.

UNIT V   RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 8

Powder injection moulding – Shot peen hardening of gears – Production of aluminium MMC liners for engine blocks – Plasma spray coated engine blocks and valves – Recent developments in auto body panel forming – Squeeze casting of pistons – aluminum composite brake rotors.

                                                                    TOTAL: 45 Hours

TEXT BOOK

1. Heldt P.M., High Speed Combustion Engines, Oxford publishing co., New York, 1990.

REFERENCES

1. Haslehurst S.E., Manufacturing Technology, ELBS, London, 1990.

2. Rusinoff, Forging and forming of metals, D.B. Taraporevala Son & co Pvt ltd, Mumbai, 1995.

3. Sabroff A.M. & Others, Forging Materials & Processes, Reinhold Book Corporation, New York, 1988.

4. Upton, Pressure Die Casting, Pergamon Press, 1985.

5. High Velocity Forming of metals, ASTME, Prentice Hall of India (P) Ltd., New Delhi, 1990.

Weblinks:

* https: nptel.ac.in courses
* https: swayam.gov.in

COURSE OUTCOME:

CO1:	Summarize the knowledge on basic principle of powder metallurgy manufacturing process.	K3
CO2:	Research on forming process in which various automotive components, manufacturing process.	K3
CO3:	Analyze the casting and machining process in which various automotive components manufacturing	K4
CO4:	List the various gear manufacturing process.	K5
CO5:	Illustrate the powder injection moulding	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	2	2	2	2	3	2
CO3	3	2	2	2	-	-	-	-	2	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	2	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PCAU15	AUTOMOTIVE ENGINE COMPONENTS DESIGN LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:

➤ To familiarize the students to use modeling software to model and design the engine components design.

LIST OF EXPERIMENTS

1. Design and drawing of the piston
2. Piston pin and piston rings and drawing of these components.
3. Design of connecting rod small end and big end, shank design, big end cap, bolts and drawing of the connecting rod assembly.
4. Design of crankshaft and balancing weight calculation.
5. Development of short and long crank arms, front end and rear end details, and drawing of the crankshaft assembly
6. Design and drawing of the flywheel
7. Ring gear design, drawing of the flywheel, including ring gear teeth development
8. Design and drawing of the inlet and exhaust valves.
9. Design of cam and camshaft, cam profile generation, drawing of cam and camshaft
10. Complete design of clutch components.

THE LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. Computer nodes - 30 Nos
2. Software like AutoCAD or Pro-E - 15 licenses

TOTAL: 45 hours

Text Books:

1. N. K. Giri, Automotive Mechanics, Khanna Publishers, New Delhi, 2005.
2. Heldt, P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co., Kolkata, 2002.

Reference Books:

1. Heinz Heisler, Advanced Vehicle Technology, Butterworth-Heinemann Ltd; 2nd revised editionedition, 2002.
2. R. B Gupta, Automobile Engineering, Satya Prakashan, New Delhi, 2013.

Web Links:

1. https://nptel.ac.in/courses/112104031
2. https://nptel.ac.in/courses/112102101

COURSE OUTCOMES

CO1:	Demonstrate the knowledge on designing components to withstand the loads and deformations.	K3
CO2:	Synthesize, analyze and document the design of the various components	K3
CO3:	Demonstrate the ability to use engineering techniques for developing vehicle components with industry standards	K3
CO4:	Perform the design of the crankshaft, balancing weight calculations	K3
CO5:	Understand the complete methodology of design &drafting	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	3	-	-	-	-	3	-	2	2	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22PCAU16	PERFORMANCE AND EMISSION TESTING LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:

➤ To conduct performance test and emission test on the IC engines

➤ Study and analysis of engine performance characteristics and engine emissions.

LIST OF EXPERIMENTS

1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for IC engine testing

2. Performance study of petrol and diesel engines both at full load and part load conditions.

3. Morse test on petrol and diesel engines

4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines

5. Heat balance test on an automotive engine.

6. Testing of 2 and 4 wheelers using chassis dynamometers.

7. Study of NDIR Gas Analyzer and FID

8. Study of Chemiluminescent NOx analyzer

9. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer

10. Diesel smoke measurement.

TOTAL: 45 hours

Text Books:

1. Institution of Mechanical Engineers, Internal Combustion Engines: Improving Performance, Fuel Economy and Emissions, Woodhead Pub Ltd

2. James Halderman , Advanced Engine Performance Diagnosis, Pearson; 6th edition

Reference Books:

1. Gerard Meurant, Engine Testing: Theory and Practice, Elsevier Science

2. Anthony Martyr, Michael Alexande, Engine testing: Theory and Practice, Elsevier Science

Web Links:

- https://www.bharathuniv.ac.in/downloads/auto/U18PCAU3L2%20Engine%20Testing%20Emission%20Measurement%20Lab.pdf
- https://archive.nptel.ac.in/courses/112/104/112104033

COURSE OUTCOMES

CO1:	Define the Pressure pickups, charge amplifier, storage oscilloscope and signal analyzers	K3
CO2:	Define the Pressure pickups, charge amplifier, storage oscilloscope and signal analyzers	K3
CO3:	Evaluate the performance of petrol and diesel engines both at full load and part load conditions	K4
CO4:	Perform the Morse test on petrol and diesel engines	K3
CO5:	Perform the Heat balance test on an automotive engine	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	3	2	2	2	3	-	-	-	-	3	-	2	3	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration Presentation	Open book test
			✓	✓	

22PCAU17	INDUSTRIAL TRAINING	L	T	P	Credits
		0	0	4	2

Course Objective:

The objective of an industrial visit is to provide the students an insight regarding the internal working of companies. Today, we all perfectly understand that theoretical knowledge is just not enough for a successful professional career. It is here that by going beyond academics, industrial visit provides students a much relevant practical perspective of the actual work place and the larger world of industries. Industrial visits provide the students with an opportunity to learn practically through interaction, working methods and employment practices. Industrial visit helps students to combine their theoretical knowledge of business operations with the practical knowledge of its actual functioning. This final report shall be typewritten form as specified in the guidelines.

22PCAU18	TWO AND THREE WHEELERS	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand constructional details, operating characteristics and vehicle design aspects.

➤ To familiarize with heavy-duty and light-duty vehicles.

UNIT I POWER UNIT   9

Two-stroke SI engine, four-stroke SI engine; merits and demerits, Symmetrical and unsymmetrical port timing diagrams, Types of scavenging processes, merits and demerits, scavenging pumps, Rotary valve engine, Fuel system, Lubrication system, Magneto coil and battery coil spark ignition system, electronic ignition system, Starting system, Kick-starter system.

UNIT II CHASSIS AND SUB-SYSTEMS   9

Mainframe and its types, Chassis and shaft drive, Single, multiple plates and centrifugal clutches, Gearbox and gear controls, Front and rear suspension systems, Shock absorbers, Panel meters and controls on the handlebar.

UNIT III BRAKES, WHEELS AND TYRES   9

Brakes-Drum brakes, disc brakes, front and rear brake links, layouts, Wheels-Spoked wheel, cast wheel, disc wheel, and disc types, Tyres and tubes.

UNIT IV TWO WHEELERS   9

Case study of major Indian models of motorcycles, scooters and mopeds; TVS mopeds and motorcycles, Hero Honda motorcycles, Bajaj scooters and motorcycles, Yamaha, Enfield motorcycles, Servicing and maintenance.

UNIT V THREE WHEELERS   9

Case study of major Indian models of three-wheeler; Bajaj Auto rickshaws, pickup vans, delivery vans; Ape load autos and trailer; Servicing and Maintenance: daily, weekly, monthly; Fault tracing.

TOTAL: 45 hours

Text Books:

1. Irving, P.E. – Motor Cycle Engineering - Temple Press Book, London – 1992.

Reference Books:

1. The Cycle Motor Manual - Temple Press Limited, London - 1990

2. Encyclopedia of Motorcycling – 20 volume Marshall, Cavensih, UK - 1989

3. Brayant R. V, Vespa - Maintenance and Repair Series – S.Chand & Co., New Delhi - 1986.

4. Raymond Broad Lambretta - A Practical Guide to maintenance and repair – S.Chand. & Co., New Delhi - 1987.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_de02/preview

2. https://nptel.ac.in/courses/107103084

COURSE OUTCOMES

CO1:	Clearly explain the scavenging processes	K3
CO2:	Explain the electronic ignition system	K3
CO3:	Familiar with the shaft drive	K3
CO4:	Describe the Suspension system	K3
CO5:	Familiar with the different types of brake	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	2	1	1	-	-	-	-	-	-	-	1	2
CO 2	3	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	1	1	-	-	-	-	-	-	-	1	1
CO 5	2	1	1	2	X	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU19	AUTOMOTIVE CHASSIS COMPONENTS DESIGN	L	T	P	Credits
		3	1	0	4

Course Objective:

➤ To study the Constructional details and Theory of important drivelines

➤ To familiarize with the Steering, Braking and Suspension Systems of Automobiles:

UNIT I VEHICLE FRAME AND SUSPENSION 9

Study of loads-moments and stresses on frame members. Design of frame for passenger and commercial vehicle – Design of leaf Springs-Coil springs and torsion bar springs.

UNIT II FRONT AXLE AND STEERING SYSTEMS 9

Analysis of loads-moments and stresses at different sections of the front axle. Determination of bearing loads at Kingpin bearings. Wheel spindle bearings. Choice of Bearings. Determination of optimum dimensions and proportions for steering linkages, ensuring minimum error in steering. Design of front axle beam.

UNIT III CLUTCH 9

Design of single plate clutch, multi-plate clutch and cone clutch. Torque capacity of clutch. Design of clutch components. Design details of roller and sprag type of clutches.

UNIT IV GEARBOX 9

Gear train calculations, the layout of gearboxes. Calculation of bearing loads and selection of bearings. Design of three-speed and four-speed gearboxes.

UNIT V DRIVELINE AND REAR AXLE 9

Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of the final drive.

TOTAL: 45 hours

Text Books:

1. Giri, N.K., "Automobile Mechanics", Khanna publishers, New Delhi, 2007.
2. Khurmi, R.S. & Gupta, J.K., "A textbook of Machine Design", Eurasia Publishing House (Pvt) Ltd, 2001.

Reference Books:

1. Dean Averns, "Automobile Chassis Design", Illife Book Co., 2001.
2. Heldt, P.M., "Automotive Chassis", Chilton Book Co., 1992

Web Links:

1. https://nptel.ac.in/courses/107106088
2. https://www.pdfdrive.com/the-automotive-chassis-volume-1-components-design-mechanical-engineering-series-e184037673.html

COURSE OUTCOMES

CO1:	Analyze the frames in vehicles	K4
CO2:	Explain testing of frames and materials used in frames	K3
CO3:	Describe the construction details of steering linkages	K3
CO4:	Sketch the steering linkages layout for conventional and independent suspensions	K3
CO5:	Evaluate the effect of driving thrust and torque	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	1	1	2	-	-	-	-	-	-	-	2	1
CO 2	2	2	2	2	2	-	-	-	-	-	-	-	1	2
CO 3	2	2	1	1	2	-	-	-	-	-	-	-	1	2
CO 4	1	1	2	2	1	-	-	-	-	-	-	-	1	1
CO 5	2	2	2	1	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU20	AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS	L	T	P	Credits
		3	0	2	4

Course Objective:
➤ To be familiar with charging, the ignition system used in automobiles.
➤ Understand the construction and applications of electrical and electronics components in various automotive electrical circuits.

UNIT I BATTERIES AND STARTING SYSTEM   10
Different types of Batteries – principle, rating, testing and charging. Starter motors characteristics, capacity requirements. Drive mechanisms. Starter switches.

UNIT II CHARGING SYSTEM LIGHTING AND ACCESSORIES   9
DC Generators and Alternators their characteristics. Control unit – cut out electronic regulators. Vehicle interior lighting system. Vehicle exterior lighting system. Wiring requirements. Lighting design. Dashboard instruments. Horn, trafficator.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEM   9
Spark plugs. Advanced mechanisms. Different types of ignition systems. Electronic fuel injection systems, mono and multi-point fuel injection system (MPFI).

UNIT IV SAFETY SYSTEMS   8
Anti-Lock braking system, airbag restraint system, voice warning system, seat belt system, road navigation system, anti-theft system.

UNIT V SENSORS AND MICROPROCESSORS IN AUTOMOBILES   9
Basic sensor arrangements. Types of sensors – oxygen sensor, hot wire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor. Microprocessor and microcomputer-controlled devices in automobiles such as voice warning systems, travel information systems, keyless entry systems, automatic transmisson systems, and electronic steering systems.

                                                        TOTAL: 45 hours

Text Books:
1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press-1999.
2. William B.Riddens "Understanding Automotive Electronics", 5th edition - Butter worth Heinemann Woburn, 1998.
3. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.

Reference Books:
1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.
3. Kholi. P.L. "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi 1975.
4. Robert Bosch "Automotive Handbook", SAE (5th Edition), 2000.

5. Ganesan. V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.

Web Links:
1. https://www.sathyabama.ac.in/course-materials/automotive-electrical-and-electronics
2. https://nptel.ac.in/courses/107106088

COURSE OUTCOMES

CO1:	Acquire the knowledge of Electrical and Electronics engineering concepts	K3
CO2:	Understand the purpose, construction and working of different batteries and electrical systems used in Automobiles	K3
CO3:	Identify, demonstrate and compare the various components and systems of Auto electrical system	K4
CO4:	Obtain an overview of automotive components, subsystems, design cycles, communication protocols	K3
CO5:	Interface automotive sensors and actuators with microcontrollers	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	3	3	3	-	-	-	-	-	-	2	3
CO 3	3	3	2	3	3	-	-	-	-	-	-	-	3	2
CO 4	3	3	1	2	3	-	-	-	-	-	-	-	3	2
CO 5	3	3	3	2	3	-	-	-	-	-	-	-	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU21	MECHATRONICS LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objectives:
1. To provide experimental insight into the applications of different sensors, signal conditioning circuits and measurement techniques.
2. To render practical experience in the design and development of Hydraulic, Pneumatic and Electric actuator circuits that is required to develop Mechatronics Systems

LIST OF EXPERIMENTS:

1. Measurement of Displacement, Force and Temperature using Transducers and Data Acquisition System
2. Modeling and Analysis of basic Hydraulic, Pneumatic, Electro-Pneumatic, Electrical and Electronic Circuits by using simulation software
3. Actuation of double acting cylinder by using Hydraulic, Pneumatic and Electro-Pneumatic circuits
4. Automating the cylinder sequence A+B+B-A- by using Microcontroller
5. PLC Automation with Timers and Counters – Cylinder Sequencing – Sorting of Objects on Conveyor Belt
6. DC Drives – Speed and Direction Control by using Microcontroller
7. AC Drives – Speed and Direction Control by using Microcontroller
8. Stepper Motor – Position, Speed and Direction Control
9. Servo Motor – Position, Speed and Direction Control
10. Automatic Temperature Control System – Interfacing of temperature sensor, cooling system (Fan), LCD Display with Microcontroller.

TOTAL = 60 PERIODS

Text book:
1. David Alciatore and Michael Histand, Introduction to Mechatronics Laboratory Excercises, McGraw-Hill Education
2.

Reference book:
1. Musa Jouaneh, Laboratory Exercises in Mechatronics, CENGAGE Learning Custom Publishing

Weblink

1. https://www.uab.edu/engineering/me/research/mechatronics-lab

COURSE OUTCOMES:

CO1:	Demonstrate the measurement of physical quantity such as displacement, force and temperature, and also the operation of signal conditioning circuits.	K3
CO2:	Devise appropriate circuits to automate and control the Hydraulic, Pneumatic, and Electric actuators.	K5
CO3:	Implement PLC, PID and microcontroller as a control unit in the Mechatronics System.	K5
CO4:	Develop a model of robot by using simulation software, and also execute real-time control over a Robot by IoT.	K5
CO5:	Implement image processing techniques to develop machine vision systems.	K5

MAPPING OF PROGRAM OUTCOMES WITH COURSE 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	PS O1	PS O2
CO 1	3	1	2	2	1	-	1	-	3	-	2	2	1	1
CO 2	3	1	2	2	2	-	1	-	3	-	2	2	2	2
CO 3	3	1	2	2	3	-	1	-	3	-	2	2	3	3
CO 4	3	1	2	2	3	-	1	-	3	-	2	2	3	3
CO 5	3	1	2	2	3	-	1	-	3	-	2	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22PCAU22	SUMMER INTERNSHIP	L	T	P	Credits
		0	0	4	2

Course Objective:

The objective of the in-plant training is to enhance and improve the skill set and knowledge of the automobile engineering students which boost their performance and consequently helping them to meet their career objectives. Training helps learners to acquire the latest techniques, skills, methodologies and to build a strong foundation for their career growth. Three periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the faculty. The student has to undergo a training of 10 to 12 days during the semester in the automotive related industries and submit a detailed report based on the industry, products and services, things learned from the industry. This final report shall be typewritten form as specified in the guidelines.

22PCAU23	VEHICLE MAINTENANCE	L	T	P	Credits
		3	1	0	4

Course Objective:

➤ To have complete knowledge of the vehicle maintenance procedures
➤ To impart knowledge on engine maintenance – repair and overhauling

UNIT I MAINTENANCE OF RECORDS AND SCHEDULES   10

Requirements and importance of maintenance, types of maintenance, preparation of checklists, Inspection schedule, maintenance of records, log sheets and other forms, and safety precautions in maintenance. The motor vehicle acts, insurance etc and traffic rules, motor vehicle driving rules and regulations.

UNIT II ENGINE MAINTENANCE – REPAIR AND OVERHAULING   9

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, including modern engines.

UNIT III CHASSIS MAINTENANCE – REPAIR AND OVERHAULING   10

Mechanical and automobile clutch, fluid flywheel, torque converter, automatic transmission and gearbox, servicing and maintenance. Maintenance servicing of the 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.

UNIT IV ELECTRICAL AND ELECTRONIC SYSTEM MAINTENANCE   8

Testing methods for checking electrical and electronic components, checking the battery, starter motor, charging systems, DC generator and alternator, ignitions system, and lighting systems. Fault diagnosis and maintenance of modern electronic controls, checking and servicing of dashboard instruments.

UNIT V MAINTENANCE OF FUEL, COOLING, LUBRICATION SYSTEMS AND VEHICLE BODY   9

Servicing and maintenance of fuel systems 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 actuate system maintenance.

                                                        TOTAL: 45 hours

Text Books:
1. John Doke "Fleet Management", McGraw-Hill Co. 1984.
2. Automotive Mechanics W.H. crouse
Reference Books:

1. James D Halderman - Advanced Engine Performance Diagnosis–PHI 1998.
2. Service Manuals from Different Vehicle Manufacturers. 66

3. Automobile Engineering by Kirpal Singh
4. Bosch Hand Book – 3rd Edition SAE 1993

Web Links:

1. https://nptel.ac.in/courses/112105048
2. https://onlinecourses.swayam2.ac.in/nou21_me10/preview

COURSE OUTCOMES

CO1:	Demonstrate the dismantling of engine components and cleaning	K4
CO2:	List the minor and major reconditioning of various engine components	K3
CO3:	Illustrate the maintenance and servicing of suspension systems	K3
CO4:	Analyze the testing methods for checking the battery, starter motor, charging systems, ignitions system	K3
CO5:	Discuss the fault diagnosis and maintenance of modern electronic controls	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	1	2	1	1	-	-	-	-	-	-	-	3	2
CO 2	2	2	1	2	1	-	-	-	-	-	-	-	2	1
CO 3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	1	1	1	1	1	-	-	-	-	-	-	-	1	1
CO 5	3	2	2	2	2	-	-	-	-	-	-	-	3	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
✓	✓		✓		✓

22PCAU24	VEHICLE MAINTENANCE & RECONDITIONING LABORATORY	L	T	P	Credits
		0	0	2	1

Course Objective:
- Ensure the maximum availability of vehicles without any major problem.
- Educate the customer about safe driving.

LIST OF EXPERIMENTS FOR VEHICLE MAINTENANCE

1. Study and Layout of Automobile Repair Shop.
2. Study and Preparation of Workshop Statements.
3. Study and List of Tools and Instruments.
4. Minor and Major Tuning of Diesel and Petrol Engines.
5. Fault Diagnosis of Ignition, Starting and Charging System.
6. Fault Diagnosis of Petrol and Diesel Fuel System and Filters & Air Cleaners.
7. Fault Diagnosis of Lighting System Horn & Wiper.
8. Performing Body Repair Works.
9. Adjustment Of Pedal Play In Clutch Brake, Hand Brake and Steering Wheel.
10. A) Bleeding Of Hydraulic Brake System and Diesel Fuel System
    B) Wheel Bearing Adjustment.
    C) Adjustment of Headlights.

LIST OF EQUIPMENTS FOR VEHICLE MAINTENANCE LABORATORY

1. Cylinder reboring – checking the cylinder bore.
2. Valve grinding, valve lapping.
3. Setting the valve angle and checking for valve leakage
4. Wheel alignment – testing of camber, caster
5. Testing kingpin inclination, toe-in and toe-out
6. Brake adjustment
7. Brake bleeding
8. Removal of Tyre & Tube.

LIST OF EXPERIMENTS FOR VEHICLE RECONDITIONING

1. Engine Analyzer
2. Cylinder compression pressure gauge
3. Vacuum gauge
4. Spark plug cleaner and tester
5. Cam angle and rpm tester
6. Tacho-meter
7. Wheel alignment apparatus
8. Gas welding equipment
9. Bearing puller
10. Headlight alignment gauge
11. Service manuals of petrol and diesel engines

LIST OF EQUIPMENTS FOR VEHICLE RECONDITIONING

1. Cylinder re-boring machine
2. Valve grinding machine
3. Valve lapping machine

4. Wheel alignment apparatus
5. Tyre remover

TOTAL: 45 hours

Text Books:
1. John Doke "Fleet Management", McGraw-Hill Co. 1984.
2. Automotive Mechanics W.H. crouse

Reference Books:
1. James D Halderman – Advanced Engine Performance Diagnosis–PHI 1998.
2. Service Manuals from Different Vehicle Manufacturers.

Web Links:
1. https://www.bharathinnr.ac.in/downloads/auto/U15LCAU7L2%20%20%20Vehicle%20Maintenance%20and%20Reconditioning%20Lab.pdf
2. https://www.thrall.org/readyref/Automobiles.html

COURSE OUTCOMES

CO1:	Explain the preparation of workshop layout and statements	K3
CO2:	Describe the tools and instruments required for workshop	K3
CO3:	Demonstrate the fault diagnosis of electrical systems	K3
CO4:	Demonstrate the fault diagnosis of air and fuel systems	K3
CO5:	Perform adjustment of Clutch, Brake and Steering	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	3	3	2	2	3	2
CO3	3	2	2	2	-	-	-	-	3	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	3	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	MCQ	Projects	Viva	Demonstration/ Presentation	Open book test
			✓	✓	

22EEAU01	PROJECT PHASE - I	L	T	P	Credits
		0	0	10	5

Course Objective:

The objective of the project work is to enable the Student who individually carryout the project. This Project which involves theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time of the institution. Six periods per week shall be allotted in the time table and this time shall be utilised by the students to receive the directions from the guide on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines. The continuous assessment shall be made as prescribed by the regulation.

22EEAU02	PROJECT PHASE - II	L	T	P	Credits
		0	0	20	10

Course Objective:

The objective of the project work is to do a project individually which involves theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted i the time of the institution. Six periods per week shall be allotted in the time table and thi s time shall be utilized by the students to receive the directions from the guide, on librar reading, laboratory work, computer analysis or field work as assigned by the guide and als to present in periodical seminars on the progress made in the project. Each student shall finally produce a comprehensive report covering background information, literature survey problem statement, project work details and conclusion. This final report shall be typewrite form as specified in the guidelines.

The continuous assessment shall be made as prescribed by the regulation.

		L	T	P	Credits
22PEAU01	VEHICLE DYNAMICS	3	0	0	3

Course Objective:

- To study about vibrations and how to reduce the vibration under different loads
- To familiarize with speed and road conditions in order to improve the comfort of the passengers

UNIT I BASIC OF VIBRATION   12

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility. Vibration absorber. Vibration measuring instruments. Two degrees of freedom system. Modal analysis.

UNIT II TYRES   12

Tire forces and moments. Tire structure. Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Test on Various road surfaces. Tire vibration.

UNIT III PERFORMANCE CHARACTERISTICS OF VEHICLE   12

Equation of motion and maximum tractive effort. Aerodynamics forces and moments. Power plant and transmission characteristics. Prediction of vehicle performance. Braking performance- Braking Force, Brake Factor, Braking Efficiency and Stopping Distance.

UNIT IV HANDLING CHARACTERISTICS OF VEHICLES   12

Mathematical model of handling. Fundamental condition for true Rolling Steady State Handling. Slip angle, cornering power. Neutral steer, understeer and oversteer. Steady-state response. Lateral Acceleration. Transient response characteristics. Directional stability of the vehicle.

UNIT V DYNAMICS OF SUSPENSION SYSTEM   12

Requirements of the suspension system. Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft. Hydraulic dampers and choice of damping characteristics. Compensated suspension system.

TOTAL: 60 hours

Text Books:

1. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., 2002
2. J.Y.Wong," Theory of ground vehicle', 4th Edition, John Wiley and Sons Inc., Newyork, 2008.
3. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint Khanna Publishers, Delhi, 2005.

Reference Books:

1. Massimo Guiggiani, "The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars", Springer, 2014 edition
2. Groover, "Mechanical Vibration", 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.
3. W Steeds, "Mechanics of road vehicle", Iliffe Books Ltd, London 1992
4. JG Giles, "Steering, Suspension tyres", Iliffe Books Ltd London 1975
5. P.M Heldt, "Automotive chassis", Chilton Co., Newyork, 1982

Web Links:

1. https://nptel.ac.in/courses/107106080
2. https://ed.iitm.ac.in/~shankaram/Course_Files/ED5220/ED5220.htm

COURSE OUTCOMES

CO1:	Describe the vehicle vibration and simulation modeling	K3
CO2:	Define the vehicle degrees of freedom	K3
CO3:	Describe the force and moment on tyre	K3
CO4:	Clearly explain the tyre properties	K3
CO5:	Familiar with the Aerodynamics forces and moments	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	2	1	1	2	-	-	-	-	-	-	-	1	2
CO 2	1	1	1	2	1	-	-	-	-	-	-	-	1	1
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22PEAU02	AUTOMOTIVE ENGINE COMPONENTS DESIGN	L	T	P	Credits
		3	0	0	3

Course Objective:

- To make the students understand the design concept and principles of various engine components. These concepts and principles are familiarized for design of components.
- To make students familiar with engine components.

UNIT I INTRODUCTION 9

Engineering materials - Introduction endurance limit, notch sensitivity, Tolerances, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness, Rankine's formula - Tetmajer's formula - Johnson formula- design of push- rods.

UNIT II DESIGN OF CYLINDER, PISTON AND CONNECTING ROD 9

Choice of material for cylinder and piston, design of cylinder, piston, and piston pin, piston rings, piston failures, lubrication of piston assembly, Material for connecting rod, determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts.

UNIT III DESIGN OF CRANKSHAFT 9

Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.

UNIT IV DESIGN OF FLYWHEELS 9

Determination of the mass of a flywheel for a given co- efficient of speed fluctuation. Engine flywheel - stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram.

UNIT V DESIGN OF VALVES AND VALVE TRAIN 9

Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam &camshaft. Design of rocker arm. Cam profile generation.

TOTAL: 45 HOURS

Text Books:

1. Khurmi, R.S. &Gupta J.K., A textbook of Machine Design, Eurasia Publishing House (Pvt) Ltd, 2001.
2. Ganesan V, "Internal combustion engines", 4th edition, Tata McGraw Hill Education, 2012.
3. Rajput R. K, "A textbook of Internal Combustion Engine", 3rd edition, Laxmi Publications (P) Ltd, 2016.

Reference Books:

1. Jain P.K, "Machine Design", Khanna Publishers, New Delhi, 2005.
2. Giri N.K, Automobile Mechanics, Khanna Publishers, New Delhi, 2007.

Weblinks:

- https://onlinecourses.nptel.ac.in/noc20_de06/preview
- https://www.vidyarthiplus.com/vp/Thread-AT6601-Automotive-Engine-Component-Design-Lecture-Notes-All-Units

COURSE OUTCOMES

CO1:	Define the concept of interference fits & surface finish	K3
CO2:	Describe the Rankine's formula, Tetmajer's formula & Johnson formula	K4
CO3:	Explain the concepts of cylinder and piston design	K3
CO4:	Analyze the Material for connecting rod.	K4
CO5:	Familiar with the various types of firing order.	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO11	PSO1	PSO2
CO 1	3	3	3	2	3								3	3
CO 2	2	2	3	3	2								2	2
CO 3	2	2	3	2	3								2	2
CO 4	3	3	2	3	2								3	3
CO 5	2	3	3	2	3								2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU03	AUTOMOTIVE POLLUTION AND CONTROL	L	T	P	Credits
		3	0	0	3

Course Objective

➤ To impart knowledge in automotive pollution control techniques of pollutants like UBHC, CO, NOx, particulate matter and smoke for both SI and CI engines will be taught to the students.

UNIT I EMISSION FROM AUTOMOBILES 5

Vehicle population assessment in metropolitan cities and contribution to pollution, effects on human health and environment, global warming, various emissions from Automobiles — Formation, transient operational effects on pollution.

UNIT II EMISSIONS FROM SPARK IGNITION ENGINE AND ITS CONTROL 12

Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon Nitric oxide Lead particulate—Poly-nuclear Aromatic hydrocarbon emissions—Effects of design and operating variables on emission formation- controlling of pollutants from Engine- Thermal reacts — Catalytic converters — Charcoal Canister Control for evaporative emission — Positive Crankcase ventilation system for UBHC emission reduction

UNIT III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 12

Physical and Chemical delay — Significance — Intermediate Compounds Formation — emission formation due to incomplete Combustion — Effect of Operating variables on Emission formation — White, Blue, and Black Smokes Nitric Oxide and Particulate controlling of Emission — Operating Behavior- Fumigation EGR- Air Injection — Cetane number Effect.

UNIT – IV NOISE POLLUTION FROM AUTOMOBILES 8

Causes for Noise from Automobiles—Traffic Noise—Engine Noise—Transmission Noise—vehicle structural Noise, Exhaust Noise, Noise reduction in Automobiles — Encapsulation technique for noise reduction — Silencer Design on Sound reduction in automobiles.

UNIT – V TEST PROCEDURES AND EMISSION MEASUREMENTS 8

Constant Volume Sampling I and 3 (CVS1 &CVS3) Systems- Sampling Procedures — Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Quantifying Emissions — Measurement of CO, CO by NDIR, Hydrocarbon emission by FID- Chemiluminescent detector for Measurement of NOR— Smoke meters — Dilution Tunnel Technique for particulate Measurement- Sound level meters.

TOTAL: 45 hours

Text Books

1. G.P Springer and D.J Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York, 1986.
2. D.J Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Ann Arbor Science Publication, 1985.

Reference Books:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co. Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill Company, Newyork 1995.
3. L.Lberanak, 'Noise Reduction', Mcgrayhill Company, Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths ltd., London1990.

Web Links:

1. https://nptel.ac.in/courses/112104033
2. https://quixp.com/nptel-air-pollution-and-control-assignment-4/

COURSE OUTCOMES

CO1:	Analyze the impact of vehicle population on pollution	K4
CO2:	Describe the emission and its effect on human health and environment	K3
CO3:	Describe the formation of pollutant in SI engine	K3
CO4:	Identify the formation of pollutant in CI engine	K4
CO5:	Clearly explain the various noise and noise reduction in automobile	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	1	1	1	1	1	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	1	1	2	1	-	1	-	-	-	-	-	2	1
CO 4	1	1	2	1	1	2	1	-	-	-	-	-	1	1
CO 5	2	2	2	2	1	1	-	-	-	-	-	-	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU04	SIMULATION OF IC ENGINE PROCESSES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand combustion phenomenon inside the cylinder and its computer simulation

➤ To impart knowledge in the simulation of IC engine processes.

UNIT I INTRODUCTION 9

Introduction The heat of reaction, complete combustion in CHON Systems, Constant volume adiabatic combustion, constant pressure adiabatic combustion. Calculation of adiabatic flame temperature.

UNIT II SI ENGINE SIMULATION 9

Deviation between actual and air standard cycles of operation- problems. SI engine simulation with adiabatic constant volume combustion with fuel and air being considered, calculation of temperature drop due to fuel vaporization, calculation of mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions.

UNIT III ACTUAL CYCLE SIMULATION IN SI ENGINES 9

Progressive combustion, gas exchange process, heat transfer process, friction. Validation of the computer code with experimental data based on performance parameters and pressure crank angle diagram.

UNIT IV SIMULATION OF 2-STROKE SI ENGINE 9

Simulation of the scavenging process, determination of the pressure-crank angle variation, computation of performance parameters.

UNIT V DIESEL ENGINE SIMULATION 9

Main difference between SI and CI engine simulation, differences between ideal and actual cycles, zero-dimensional combustion model for diesel engine, heat transfer and gas exchange processes. Performance prediction and comparison of results.

TOTAL: 45 hours

Text Books:

1. Ganesan. V. - Computer Simulation of spark ignition engine process, -Universities Press (I) Ltd, 1996.

2. Ganesan. V. - Computer Simulation of compression ignition engine process – Universities Press (I) Ltd, 2000.

3. Ashley Campbel - Thermodynamic analysis of combustion engines - John Wiley and Sons, New York - 1986.

Reference Books:

1. Benson. R.S., Whitehouse. N.D. - Internal Combustion Engines - Pergamon Press, oxford, 1979

2. Ramoss. A.L., - Modelling of Internal Combustion Engine Processes - McGraw-Hill Publishing Co., 1992.

Web Links:

1. https://coursesity.com/course-detail/internal-combustion-engines-online-video-course
2. https://nptel.ac.in/courses/112103262

COURSE OUTCOMES

CO1:	Describe the classifications and applications of engine cycle simulation model	K3
CO2:	Grasp the major modeling and simulation methods and the influence of model	K4
CO3:	Familiar with the modeling of filling/ emptying method and ability to build up control-oriented simulation model	K3
CO4:	Familiar with the essential models of engine cycle simulation and calculation of engine parameters	K3
CO5:	Simulate the different engine processes	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	1	-	-	-	-	-	-	-	3	2
CO2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO3	2	2	3	1	1	-	-	-	-	-	-	-	2	1
CO4	2	1	3	2	2	-	-	-	-	-	-	-	2	1
CO5	1	2	3	1	2	-	-	-	-	-	-	-	3	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

		L	T	P	Credits
22PEAU05	VEHICLE BODY ENGINEERING	3	0	0	3

Course Objective:
➤ To impart knowledge in the construction of vehicles.
➤ To familiarize the aerodynamic concept & paneling of the passenger car body.

UNIT I CAR BODY DETAILS   9

Types of car bodies - visibility: regulation, driver's visibility, methods of improving visibility-safety: safety design, safety aspects. Constructional details of a passenger car.

UNIT II BUS BODY DETAILS   9

Classification of bus bodies – based on distance traveled, based on the capacity of the bus and based on style & shape. Types of metal sections used in the construction. Construction of Conventional and integral type buses.

UNIT III CAR AERODYNAMICS   9

Objects — Vehicle types of drag. Various types of forces and moments. Effects of forces and moments.   Various body optimization techniques for minimum drag. Principle of wind tunnel technology. Flow visualization techniques. Test with scale models.

UNIT IV COMMERCIAL VEHICLE DETAILS   9

Classification of commercial vehicle bodies. Construction of Tanker body and Tipper body. Dimensions of driver's seat in relation to controls. Driver's cab design. The compactness of the Driver's cab. Segmental construction of driver's cab.

UNIT V COMMERCIAL VEHICLE AERODYNAMICS   9

Effects of rounding sharp front body edges. Effects of the different cab to trailer body for body pressure distribution. Effects of a cab to trailer body roof height. Commercial vehicle drag-reducing devices. Modern painting process of a passenger car body.

TOTAL: 45 hours

Text Books:

1   Pawloski, J., 'Vehicle Body Engineering', Business Books Ltd, 1970
2   J.G. Giles, 'Body Construction and Design', Butterworth and Co., 1975

Reference Books

1   John Fenton 'Vehicle Body layout and analysis', Mechanical Engineering Publication Ltd., 1984
2   Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002

Web Links:

1   https://nptel.ac.in/courses/107105084
2   https://nptel.ac.in/courses/107106088

COURSE OUTCOMES

CO1:	Describe the concept of car body design	K3
CO2:	Explain the passenger safety, crumple zone and crash testing	K3
CO3:	Explain the concepts of wind tunnel testing	K3
CO4:	Analyze vehicle body optimization techniques to reduce drag	K4
CO5:	Familiar with the various types of bus body construction	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O1
CO 1	1	1	2	2	2	-	-	-	-	-	-	-	1	1
CO 2	3	2	1	2	3	-	-	-	-	-	-	-	3	2
CO 3	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 4	3	1	2	2	3	-	-	-	-	-	-	-	3	1
CO 5	1	2	1	2	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU06	SPECIAL TYPES OF VEHICLES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the concept and principle of operation of special vehicles such as Bulldozers, Ditchers, Bucket excavators, farm equipment, military vehicles etc.

➤ To enhance the knowledge of the students about the various equipment used in earthmoving applications.

UNIT I TRACTORS AND FARM EQUIPMENTS   9
Classification and power required - Design consideration - Ride and stability characteristics of power plants and transmission – Special features and constructional detail- Farm equipment.

UNIT II EARTH MOVING MACHINES   9
Construction layout, capacity and applications of earthmovers for dumpers, front-end loaders, bulldozers, excavators, backhoe loaders, scrapers, and motor graders etc. criteria for selection of prime mover from dumpers and front end loaders based on vehicle performance characteristics.

UNIT III POWERTRAIN CONCEPTS   9
Engine – converter match curves. Epicyclic type transmissions. Selection criteria for universal joints. Constructional details of steerable and drive axles of the dumper.

UNIT IV SPECIAL PURPOSE VEHICLES FOR INDUSTRIAL APPLICATIONS 9
Constructional features, capacity and stability of jib cranes. Vibratory compactors. Special features and constructional detail-Stackers, bore well machines, concrete mixtures.

UNIT V TWO AND THREE WHEELERS   9
Constructional details of engine components in moped, scooter, motorcycle and three-wheelers. Magneto ignition systems multiple disc clutch and centrifugal clutch details. Types of gearboxes, types of driver–chain drive, shaft drive, frame and front forks, and two-wheeler suspension system.

TOTAL: 45 hours

Text Books:

1. Construction Planning, Equipment and Methods – Robert L. Peurifoy, William B. Ledbetter, Clifford J. Schexnayder - McGraw-Hill, Fifth Edition.

Reference Books:

1. A. Gurevich and E. Sireking, Tractors Mir Publishers, Moscow, 1967.
2. V. Rodichev & G. Rodicheva, Tractors and automobiles, MIR Publishers, Moscow.

Web Links:

1. https://nptel.ac.in/courses/108109009
2. https://nptel.ac.in/courses/107106080

COURSE OUTCOMES

CO1:	Describe the various earth-moving equipment	K3
CO2:	Familiar with the vehicle performance characteristics	K4
CO3:	Describe the converter match curves	K3
CO4:	Explain the constructional details of steerable and drive axles of dumper	K3
CO5:	Define the OCDB and dry disc caliper brakes	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 3	-	2	2	1	1	-	-	-	-	-	-	-	-	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 5	1	1	2	2	1	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU07	ALTERNATIVE FUELS AND ENERGY SYSTEMS	L	T	P	Credits
		3	0	0	3

Course Objective:
➤ To acquire knowledge in engine design for handling and understanding various energy systems for use in automobiles.
➤ To address the underlying concepts and methods behind alternate fuel and energy systems.

UNIT I INTRODUCTION   12
Need for alternate fuel, availability and properties of alternate fuels, general use of alcohols, LPG, hydrogen, ammonia, CNG and LNG, vegetable oils and biogas, merits and demerits of various alternate fuels, introduction to alternative energy sources Like EV, hybrid, fuel cell and solar cars.

UNIT II ALCOHOLS   12
Properties as engine fuel, alcohols and gasoline blends, performance in SI engine, methanol and gasoline blends, combustion characteristics in CI engines, emission characteristics, DME, DEE properties performance analysis, performance in SI & CI Engines.

UNIT III NATURAL GAS, LPG, HYDROGEN AND BIOGAS   12
Availability of CNG, properties, modification required to use in engines, performance and emission characteristics of CNG using LPG in SI & CI engines, performance and emission of LPG, Hydrogen; storage and handling, performance and safety aspects.

UNIT IV VEGETABLE OILS   12
Various vegetable oils for engines, desertification, performance in engines, performance and emission characteristics, biodiesel and its characteristics

UNIT V ELECTRIC, HYBRID, FUEL CELL AND SOLAR CARS   12
Layout of an electric vehicle, advantages and limitations, specifications, system components, electronic control system, high energy and power density batteries, hybrid vehicle, fuel cell vehicles, solar-powered vehicles.

                                                              TOTAL: 60 hours

Text Book:

1. Richard L Bechfold – Alternative Fuels GuideBook - SAE International Warrendale - 1997.

Reference Books:

1. Maheswar Dayal - "Energy today & tomorrow" - I & B Hornbr India - 1982
2. Nagpal - "Power Plant Engineering" - Khanna Publishers - 1991
3. "Alcohols as motor fuels progress in technology" - Series No 19 - SAE Publication USE - 1980
4. SAE paper nos: 840367, 841333, 841334, 841156, Transactions, SAE, USA.

COURSE OUTCOMES

CO1:	Describe the need of the alternative fuels	K3
CO2:	Explain the need of the Gaseous fuels	K3
CO3:	Describe and ethanol usage, storage, chemical structure, pros and cons	K3
CO4:	Evaluate the performance characteristics of alcohols fuels	K4
CO5:	Describe the natural gas, LPG, hydrogen, and biogas	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	3	2	1	-	-	-	-	-	-	-	2	2
CO 2	2	2	3	3	2	-	-	-	-	-	-	-	2	2
CO 3	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	2	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam:	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU08	FINITE ELEMENT ANALYSIS	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the principles involved in discretization and finite element approach.
➤ To learn to form stiffness matrices and force vectors for simple elements.

UNIT I INTRODUCTION   12

Historical background – Matrix approach – Application to the continuum – Discretisation – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method

UNIT II ONE DIMENSIONAL PROBLEMS   12

Finite element modeling – Coordinates and shape functions- Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses

UNIT III TWO DIMENSIONAL CONTINUUM   12

Introduction – Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galarkin approach - Stress calculation – Temperature effects

UNIT IV AXISYMMETRIC CONTINUUM   12

Axisymmetric formulation – Element stiffness matrix and force vector – Galarkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM
                                                                    12

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Stress calculations – Four node quadrilateral for axisymmetric problems.

                                                     TOTAL: 60 hours

Text Books:

1. Chandrupatla T.R., and Belegundu A.D., Introduction to Finite Elements in Engineering, Pearson Education 2002, 3rd Edition.
2. David V.Hutton "Fundamentals of Finite Element Analysis"2004: McGraw-Hill Int. Ed.

Reference Books:

1. Rao S.S., the Finite Element Method in Engineering, Pergamon Press, 1989
2. Logan D.L., A First Course in the Finite Element Method, Third Edition, Thomson Learning, 2002
3. Robert D.Cook, David.S, Mallrus Michael E.Plesha, "Concepts and Applications of Finite Element Analysis", 2003.
4. Ed. Wiley.Reddy J.N., an Introduction to Finite Element Method, McGraw-Hill International Student Edition, 1985.

5. O.C.Zienkiewicz and R.L.Taylor, the Finite Element Methods, Vol.1, The basic formulation and linear problems, Vol.1, Butterworth Heineman, 5th Edition, 2000.

Web Links:

1. https://nptel.ac.in/courses/112104193
2. https://onlinecourses.nptel.ac.in/noc20_me91/preview

COURSE OUTCOMES

CO1:	Familiarize the basic concept of finite element methods	K4
CO2:	Acquire the knowledge on one-dimensional problems	K3
CO3:	Acquire the knowledge on two-dimensional continuum	K3
CO4:	Develop the skill on approaching the Heat transfer and fluid flow problems	K4
CO5:	Gain knowledge on applications of finite element method in Automobiles	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	3	2	3	-	-	-	-	-	-	-	3	3
CO 2	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 3	2	2	3	2	1	-	-	-	-	-	-	-	2	2
CO 4	3	3	2	3	2	-	-	-	-	-	-	-	3	3
CO 5	2	1	2	3	1	-	-	-	-	-	-	-	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22PEAU09	TRANSPORT MANAGEMENT	L	T	P	Credits
		3	0	0	3

Course Objective:
> After completion of this course the students are able to manage a transport fleet and their related activities for minimizing operational cost

UNIT I INTRODUCTION   9
Personnel management and functions of personnel management, psychology, sociology and their relevance to the organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training, advantages, methods of training, training procedure, psychological tests.

UNIT II TRANSPORT SYSTEMS   9
Introduction to various transport systems. Advantages of motor transport. The principle function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility, forms of ownership by the state, municipality, public body and private undertakings

UNIT III SCHEDULING AND FARE STRUCTURE   9
Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up a fare table. Various types of fare collecting methods. Basic factors of bus schedules. Problems with bus scheduling.

UNIT IV MOTOR VEHICLE ACT   9
Traffic signs, fitness certificate, registration requirements, permit insurance, construction 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.

UNIT V MAINTENANCE   9
Preventive maintenance system in the transport industry, tyre maintenance procedures. Causes for uneven tyre wear, remedies, maintenance procedure for better fuel economy. Design of bus depot layout.

                                                           TOTAL: 45 hours

Text Books:

1.   John Duke - Fleet Management – McGraw-Hill Co, USA -1984.

Reference Books:

1.   Government Motor Vehicle Act – Eastern Book Company, Lucknow - 1989
2.   Kitchin. L.D. - Bus Operation - Illiffee and Sons Co., London, III edition - 1992
3.   The motor vehicle Act 1939 - Ejaz Ahmad, Ashok law house, India – 1989

Web Links:
1.   https://nptel.ac.in/courses
2.   https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Describe the functions of Personnel Management and their relevance to the organization.	K3
CO2:	Justify the Employment tests, training procedure and psychological tests.	K3
CO3:	Illustrate the principal function of administrative, traffic, secretarial and engineering divisions.	K4
CO4:	Describe the responsibility in forms of state, municipality, public and private undertakings	K5
CO5:	State the principal features of operating costs for transport vehicles.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	3	2	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	1	1	3	2	-	-	-	-	-	-	-	2	1
CO 3	1	2	2	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	1	1	2	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	1	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

		L	T	P	Credits
22PEAU10	AUTOMOTIVE AERODYNAMICS	3	0	0	3

Course Objective:

➤ At the end of the course, the students will be able to apply basic principles of aerodynamics for the design of vehicle body

UNIT I INTRODUCTION   9

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, airflow to the passenger compartment, duct for air conditioning, cooling of the transverse engine and rear engine.

UNIT II AERODYNAMIC DRAG OF CARS   9

Cars as a bluff body, flow field around the car, drag force, types of drag force, analysis of aerodynamic drag, the drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CARS   9

Front end modification, front and rear windshield angle, boat tailing, hatchback, fastback and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

UNIT IV VEHICLE HANDLING   9

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS   9

Introduction, the principle of wind tunnel technology, limitation of simulation, stress with scale models, full-scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

TOTAL: 45 hours

Text Books:

1. Hucho. W.H. - "Aerodynamics of Road Vehicles" - Butterworths Co., Ltd., - 1997.

Reference Books:

1. Pope - "Wind Tunnel Testing" - John Wiley & Sons - 2nd Edition, New York - 1974.
2. Automotive Aerodynamic Update SP 706 - SAE – 1987.
3. Vehicle Aerodynamics - SP 1145 - SAE – 1996.

Web Links:
1. https://nptel.ac.in/courses
2. https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Evaluate basic fluid theory.	K3
CO2:	Demonstrate knowledge and understanding of aerodynamics in the automotive field.	K3
CO3:	Explain the principles and functions of wind tunnels	K4
CO4:	Conceptual understanding of mathematics, numerical analysis, statistics, and computer and information.	K5
CO5:	Application of established engineering methods to complex engineering problem solving	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	1	1	-	-	-	-	-	-	-	2	2
CO 4	3	1	1	2	2	-	-	-	-	-	-	-	3	1
CO 5	2	2	1	3	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	

Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22PEAU11	MODERN AUTOMOBILE ACCESSORIES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To introduce the modern developments in vehicle technology.

UNIT I   ENGINE MANAGEMENT SYSTEMS   9
Electronically controlled SI and CI engine fuel injection systems, related hardware and software. Closed-loop ignition system. Catalytic converters and particulate traps.

UNIT II   CHASSIS   9
Suspensions – front and rear Active suspension control- Ride Comfort, Suspension Travel Road Handling -advantages, disadvantages. Pneumatic suspensions.

UNIT III   HEATING AND AIR CONDITIONING   9
Vehicle air conditioning and heating- Compressor, condenser evaporator, working Principles. TXV operation working principle of vehicle air conditioning

UNIT IV   COMFORT AND CONVENIENCE   9
Adaptive cruise control, car entertainment, power windows, navigation system, adaptive noise control, electric seats, driver information system. Power windows, power steering

UNIT V   SAFETY AND SECURITY SYSTEMS   9
Airbags, seat belt-tightening system, collapsible and tilt-able steering column. Anti-theft system, anti-lock braking system, electronic stability control system/traction control system, rollover protection system.

TOTAL: 45 hours

Text Books:

1. Tom Denton - "Automobile Electrical and Electronic Systems" – Edward Arnold, London - 1995.
2. Eric Chowanietz - "Automotive Electronics" - SAE International USA - 1995.

Reference:

1.   Bosch Automotive Handbook - 5th Edition - SAE Publication, USA - 2000.

Web Links:

1.   https://nptel.ac.in/courses
2.   https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Familiar with the advanced fuel injection systems techniques in both the SI and CI engines	K3
CO2:	Describe the Knowledge of pneumatic &active suspension control systems.	K3
CO3:	Describe the heating and air conditioning system.	K4
CO4:	Familiar with the navigation systems, power steering, and power windows.	K5
CO5:	Gain knowledge about various safety & security systems such as airbags, seat belts, ABS, and EBS	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	2	2	2	3	3	-	-	-	-	-	-	-	2	2
CO 2	1	1	1	2	1	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 5	1	1	2	2	3	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22PEAU12	VIBRATION AND NOISE CONTROL	L	T	P	Credit
		3	0	0	3

Course Objective:

➤ The students will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I BASICS OF VIBRATION   9

Introduction, classification of vibration, free and forced vibration, undamped and damped vibration, linear and nonlinear vibration, the response of damped and undamped systems under harmonic force, analysis of single degree and two degrees of freedom systems, torsion vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE   9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES   9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

UNIT IV CONTROL TECHNIQUES   9

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V SOURCE OF NOISE AND CONTROL   9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL: 45 hours

Text Books:

1. Singresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBM –81-297-0179-0 – 2004.
2. Kewal Pujara "Vibrations and Noise for Engineers, Dhanpat Rai & Sons, 1992.

Reference Books:

1. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" – Second edition - SAE International

2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, 2004.
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, ISBN 1-86058-073- 1998.

Web Links:
1. https: nptel.ac.in courses
2. https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Describe the basic concepts of vibration.	K3
CO2:	Identify to simulate noise control and be able to design systems accordingly.	K3
CO3:	Illustrate the performance of spatial, modal and response models of vibrating systems.	K4
CO4:	Describe the concepts of engineering noise and vibration, measurement techniques and instruments.	K5
CO5:	Describe the knowledge of application dynamic forces generated by IC engines.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	1	2	2	-	-	-	-	-	-	-	3	2
CO 2	2	1	5	1	1	-	-	-	-	-	-	-	2	1
CO 3	3	2	2	2	3	-	-	-	-	-	-	-	3	2
CO 4	2	1	1	1	3	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU13	ADVANCED THEORY OF I.C. ENGINES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ At the end of the course, the students will be able to understand the significance of various processes in I.C Engines.

UNIT I   CYCLE ANALYSIS   9
Otto, Diesel, Dual, Stirling and Brayton cycles, comparison of air standard, fuel-air and actual cycles, simple problems on the above topics.

UNIT II   COMBUSTION   9
Combustion reactions and stoichiometry, the heat of reaction, the adiabatic flame temperature in constant pressure and constant volume systems, fuels for internal combustion engines and their properties, premixed and diffusion combustion as applicable to SI and CI engines, concepts of burning rate and flame velocity, fuel spray characteristics and combustion in diesel engines.

UNIT III   COMBUSTION MODELLING   9
Basic concepts of engine simulation, governing equations, and simulation of various engine processes for SI and CI engines. Adiabatic flame temperature, Heat release calculations. Thermodynamic and Fluid mechanics-based models.

UNIT IV   ADVANCES IN IC ENGINES   9
LHR engines, surface ignition concept and multi-fuel engines, stratified charge and lean-burn engines, performance and emission characteristics, merits and demerits.

UNIT V   ELECTRONIC ENGINE MANAGEMENT   9
Computer control of SI & CI engines for better performance and low emissions, closed-loop control of engine parameters of fuel injection and ignition

                                                             TOTAL: 45 hours

Text Books:

1. Ganesan, V – "IC Engines" – Tata McGraw-Hill 2005
2. John B. Haywood, "Internal Combustion Engine Fundamentals", McGraw-Hill Automotive Technology Series ISBN 0-07-1000499-8, 1988.

Reference Books:

1. Ganesan, V – 'Computer Simulation of Spark Ignition Processes' – Universities Process Ltd, Hyderabad – 1993
2. Ganesan V. – Computer Simulation of compression ignition engines – Orcent Longman – 2000.
3. Richard Stone – "Introduction to IC Engines" – 2nd edition – Macmillan – 1992.

Web Links:
1. https://nptel.ac.in/courses

2. https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Compare various cycles with actual cycles.	K3
CO2:	Familiar with combustion reactions and stoichiometry.	K3
CO3:	Understand premixed and diffusion combustion in SI and CI engines.	K4
CO4:	Optimize the concepts of engine simulation governing equations.	K5
CO5:	Describe simulation of various engine processes for SI and CI engines.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	3	2	2	2	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	5	3	2	-	-	-	-	-	-	-	1	1
CO 3	2	1	2	2	3	-	-	-	-	-	-	-	2	1
CO 4	3	2	1	3	2	-	-	-	-	-	-	-	3	2
CO 5	2	1	1	2	1	-	-	-	-	-	-	-	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU14	ENGINE AND VEHICLE MANAGEMENT SYSTEM	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To explain the principle of engines and vehicle electronic management system and different sensors used in the systems.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS   9

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.

UNIT II SENSORS   9

Inductive, Hall effect, hot wire, thermistor, piezo electric, piezoresistive based sensors. Throttle position, mass air 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, gyro sensors.

UNIT III SI ENGINE MANAGEMENT   9

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.

UNIT IV CI ENGINE MANAGEMENT   9

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 valves.

UNIT V VEHICLE MANAGEMENT SYSTEMS   9

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- alarm, vehicle tracking system. On board diagnostics. Collision avoidance Radar warning system.

TOTAL: 45 Hours

TEXT BOOKS:
1. Eric Chowanietz "Automobile Electronics" SAE Publications, 1994
2. William B Ribbens "Understanding Automotive Electronics", SAE Publications, 1998

REFERENCE BOOKS:
1. Robert Bosch "Diesel Engine Management" SAE Publications, 2006.
2. Robert Bosch, "Gasoline Engine Management" SAE Publications, 2006

Weblinks:

- https: nptel.ac.in/courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Understand the fundamentals of automotive electronics	K3
CO2:	Understand the role of various sensors, its construction and working principle	K3
CO3:	Familiar with the S.I Engine Management system	K4
CO4:	Familiar with the C.I Engine Management system	K5
CO5:	Familiar with the Vehicle Management system	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO –	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
CO 1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO 2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO 3	2	3	3	2	3	-	3	-	-	-	-	-	2	3
CO 4	1	3	2	1	1	3	1	-	-	-	-	-	1	3
CO 5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

		L	T	P	Credits
22PEAU15	METROLOGY AND MEASUREMENTS FOR AUTOMOBILE ENGINEERS	3	0	0	3

Course Objective:

➤ Knowledge in usage of software to measure parameters like speed, position, velocity, pressure, force, torque, temperature etc.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS   9

Sensors Functions- Classification- Main technical requirement and trends Units and standards-Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error-Propagation of error- Odds and uncertainty- principle of transduction- Classification- Static characteristics- mathematical model of transducers- Zero, First and Second order transducers-Dynamic characteristics of first and second order transducers for standard test inputs.

UNIT II VARIABLE RESISTANCE, INDUCTANCE AND CAPACITIVE SENSOR   11

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers – EI pick up and LVDT

Special Sensors

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor, Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT III AUTOMOTIVE PRESSURE AND FORCE-TORQUE SENSOR   9

Pressure Sensors

Typical automotive applications- Thick film pressure sensor- Semiconductor pressure sensor-Integrated silicon intake-manifold pressure sensor-Integrated silicon combustion-pressure sensor-Piezo electric sensor-High pressure sensor with metal diaphragm.

Force/Torque Sensor

Typical automotive applications- Magneto elastic bearing-pin sensor- Magneto elastic tension compressive-force sensor – Basic principle of torque measurement – steering- Angle measuring torque sensor.

UNIT IV AUTOMOTIVE POSITION AND RPM/VELOCITY SENSORS   9

Position Sensors:- Typical automotive applications- Wiper potentiometers- Short-circuiting ring sensor- Half-differential sensor- Eddy-current pedal-travel sensor- Integrated Hall IC's - Hall acceleration sensor- Knock sensors-RPM and Velocity Sensors: - Inductive rotational speed sensor-Hall effect sensor

Temperature Sensors:- Typical automotive applications -Sintered-Ceramic resistors-Thin film resistors-Thick film resistors- Monocrystalline silicon semiconductor resistor- Thermopile sensors **Flow Sensors:-** Ultrasonic flow sensors-Pitot tube air-flow sensor- Hot wire air-mass flow meter-Micro mechanical hot-film air-mass flow meter- Lambda sensor -Imaging sensor-Rain Sensor Introduction to MEMs

UNIT V METROLOGY

Basic concept - scientific, industrial and legal metrology - linear and angular measuring instruments; measurement of screw thread - Two, three wire method, measurement with optical flats, laser interferometer, coordinate measuring machine.

TOTAL: 45 Hours

TEXT BOOKS:

1. Robert Brandy, " Automotive Electronics and Computer System", Prentice Hall, 2001
2. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004

REFERENCE BOOKS:

1. Bentley JP ," Principles of Measurement Systems", 4th Edition, Addison Wesley Longman Ltd., U.K. 2004
2. Jain R. K. "Engineering Metrology" Khanna Publishers, New Delhi, 2012
3. Murthy D.V.S, "Transducers and Instrumentation", Prentice Hall of India, 2007

Weblinks:

* https://nptel.ac.in/courses
* https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Selecting suitable mechanical measuring instruments for basic and special requirement in the industries.	K3
CO2:	Calibrating and analyzing the characteristics of measuring instruments.	K3
CO3:	Designing the fits and tolerances to improve the existing performance.	K4
CO4:	Determine error and analyzing uncertainty in the measurements.	K5
CO5:	Work in quality control and quality assurances divisions in industries.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO	PO 1	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
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	2	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU16	AUTOMOTIVE SAFETY	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the various safety concepts, systems and working of safety equipment

UNIT I INTRODUCTION 9

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

UNIT II SAFETY CONCEPTS 9

Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT III SAFETY EQUIPMENTS 9

Seat belt, regulations, automatic seat belt tightened system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

UNIT IV COLLISION WARNING AND AVOIDANCE 9

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT V COMFORT AND CONVENIENCE SYSTEM 9

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system, environment information system

TOTAL: 45 Hours

TEXT BOOKS:

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.

2. J.Powloski - "Vehicle Body Engineering" - Business books limited, London - 1969.

REFERENCE BOOK:

1. Ronald K.Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw-Hill Inc. - 1999.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Familiar with the concepts of safety	K3
CO2:	Describe the various safety equipment's	K3
CO3:	Describe the electronic system for activating air bags	K4
CO4:	Familiar with the various Collision warning system.	K5
CO5:	Explain the object detection system with braking system interactions.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	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
CO1	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO2	2	1	1	2	1	-	-	-	-	-	-	-	2	1
CO3	2	2	1	1	2	-	-	-	-	-	-	-	2	2
CO4	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO5	2	2	1	2	1	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU17	OFF ROAD VEHICLES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ At the end of the course, the students will be able to understand the various Off road vehicle and their systems and features

UNIT I CLASSIFICATION AND REQUIREMENTS OF OFF ROAD VEHICLES   6

Construction layout, capacity and applications of off road vehicle – prime mover, chassis and transmission, Multi-axle vehicles.

UNIT II EARTH MOVING CONSTRUCTIONAL MACHINES   10

Dumpers – safety features, safe warning system for dumper, Design aspects on dumper body, Articulated Dumpers, loaders – single bucket, Multi bucket and rotary types – bulldozers, kinematics for loader and bulldozers with operational linkages, excavators, backhoe loaders, scrappers, motor graders, power shovel, bush cutters, Bush cutters, stumpers, rippers.

UNITY III INDUSTRIAL APPLICATIONS   10

Constructional and working details of Jib crane, concrete ready mixers, compactors – vibratory compactors, forklift, utility vehicles, man – lift, scissors, lift trucks, material handlers, power generators.

UNIT IV VEHICLE SYSTEMS AND IT FEATURES   11

Brake system and actuation – OCDB and dry disc caliper brakes, Body hoist and bucket operational hydraulics, Hydro-pneumatic suspension cylinders, Power steering system, Articulated steering assembly – power and capacity of earth moving machines.

UNIT V FARM EQUIPMENTS, MILITARY AND COMBAT VEHICLES   8

Tractors, classification – working attachments, power take off, special implements, paddy harvester, sugarcane harvester, feller bunchers, special features and constructional details of military tankers, AVLB gun carriers and transport vehicles

                              TOTAL: 45 Hours

TEXT BOOKS:

1. Abrosimov K, Bran berg A and Katayev K., "Road making machinery", MIR Publishers, Moscow, 1971.
2. Nakra C.P., "Farm machines and equipments" Dhanpatrai Publishing Company Pvt Ltd.
3. Robert L Peurifoy, "Construction planning, equipment and methods" Tata McGraw Hill Publishing company Ltd.
4. Wong J.T., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.

REFERENCE BOOKS:

1. Bart H Vanderveen, "Tanks and Transport Vehicles", Frederic Warne and Co Ltd., London Ix
2. S. Ageikin, "Off the Road Wheeled and Combined Traction Devices: Theory and Calculation", Ashgate Publishing Co. Ltd. 1988.

3. Schulz Erich J, "Diesel equipment I & II", McGraw Hill company, London, 1992.
4. Satyanarayana B., "Construction planning and equipment", standard publishers and distributors, New Delhi, 1965.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Describe the various off-road vehicles.	K3
CO2:	Familiar with the off-road vehicle application.	K3
CO3:	Describe the off-road vehicles systems ad their features	K4
CO4:	Describe the concept of concrete mixtures.	K5
CO5:	Clearly explain the military and combat vehicles.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO –	PO 1	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
CO1	1	1	1	1	3	2	2	-	-	-	-	-	1	1
CO2	2	2	2	2	1	-	1	-	-	-	-	-	2	2
CO3	2	1	1	2	3	-	1	-	-	-	-	-	2	1
CO4	1	3	2	1	1	2	1	-	-	-	-	-	1	3
CO5	2	2	2	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22PEAU18	ADVANCED PRODUCTION PROCESSES FOR AUTOMOTIVE COMPONENTS	L	T	P	Credit
		3	0	0	3

Course Objective:

➢ To learn the available manufacturing process based on quality/time/cost/ mechanical properties.

UNIT I POWDER METALLURGY 9

Process flow chart – production of metal powers and their raw materials – Manufacture of friction lining materials for clutches and brakes – testing and inspection of PM parts.

UNIT II FORMING PROCESS 9

Forging – process flow chart, forging of valves – connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, foot brake linkage, steering knuckles. Extrusion: Basic process steps, extrusion of transmission shaft, steering worm blanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pin and valve tappets. Hydro forming: Process, hydro forming of manifold and comparison with conventional methods – Hydro forming of tail lamp housing stretch forming – process, stretch forming of auto body panels – super plastic alloys for auto body panels.

UNIT III GEAR MANUFACTURING 9

Different methods of gear manufacture – Gear hobbing and gear shaping machines specifications – gear generation – different methods – gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV CONCEPT & PROGRAMMING OF CNC MACHINES 9

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feedback devices – manual part programming – steps involved – sample program in lathe & milling.

UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS 9

Power injection moulding – Shot peen hardening of gears – production of aluminum MMC liners for engine blocks – Plasma spray coated engine blocks and valves – Recent developments in auto body panel forming – Squeeze casting of pistons – aluminum composite brake rotors.

TOTAL: 45 Hours

TEXT BOOK:
1. Heldt, P.M., High Speed Combustion Engines, Oxford Publishing Co., New York, 1990

REFERENCE BOOKS:
1. Haslehurst, S.E., Manufacturing Technology, ELBS, London, 1990
2. Rusinoff, Forging and Forming of metals, D.B. Taraporevala Sons & Co., Pvt. Ltd.,Mumbai, 1995.

3. Subroff A.M. & Other, Forging Materials & Processes, Reinhold Book Corporation,New York, 1998.

4. High Velocity Forming of Metals, ASTME, Prentice Hall of India (P) Ltd., New Delhi,1990.

5. Groover, M.P. Automatic production systems and computer integrated manufacturing prentice – hall, 1990.

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Summarize the production methods of engine components chassis components	K 3
CO2:	Explain the different types of forming process used in various automobiles.	K 3
CO3:	Identify the various extrusion processes.	K 4
CO4:	Describe the different types of gear manufacturing process.	K 3
CO5:	Teach the detail procedure of gear lapping, gear honing and gear broaching methods.	K 3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO1
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	3	3	2	3	3	2
CO3	3	2	2	2	-	-	-	-	3	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	3	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

		L	T	P	Credits
22PEAU19	NOISE, VIBRATION AND HARSHNESS	3	0	0	3

Course Objective:

➢ To identify, measure and control the noise, vibration and harshness.

UNIT I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION   9

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping.

UNIT II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE 9

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Slip Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III TRANSPORTATION NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL   9

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire-Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT IV INTERIOR TRANSPORTATION NOISE AND VIBRATION SOURCES – PREDICTION AND CONTROL   9

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors- Prediction and Control

UNIT V NOISE AND VIBRATION TRANSDUCERS, ANALYSIS EQUIPMENT, SIGNAL PROCESSING, AND MEASURING TECHNIQUES   9

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Trace ability of Vibration and Shock Measurements.

TOTAL: 45 Hours

Text Books:
1. Clarence W. de Silva, "Vibration Monitoring, Testing, and Instrumentation", CRC Press, 2009
2. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice "Spon Press, London, 2009

Reference Books:
1. Alan G. Piersol, Thomas L. Paez "Harris' Shock and Vibration Handbook", McGraw-Hill, New Delhi, 2010
2. Colin H Hansen "Understanding Active Noise Cancelation", Spon Press, London 2003
3. Mathew Harrison "Vehicle Refinement: Controling Noise and Vibration in Road Vehicles", Elsevier Buterworth-Heineman, Burlington, 2004

Weblinks:
- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Identify the methods of vibration and noise measurement	K3
CO2:	Compare the effect of noise an human comfort and environment	K3
CO3:	Describe the concept of mufflers, tire-road noise	K4
CO4:	Describe the interior transportation noise and vibration sources	K5
CO5:	Describe the various noise and vibration measurements	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	3	-	3	2	-	2	3	2
CO2	2	3	2	3	1	-	3	3	-	3	1	2
CO3	3	3	3	3	3	-	3	2	-	3	3	3
CO4	3	2	3	3	1	-	3	2	-	3	3	1
CO5	2	2	2	3	2	-	1	2	-	3	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22PEAU20	NEW GENERATION AND HYBRID VEHICLES	L	T	P	Credits
		3	0	0	3

Course Objective:
➢ To understand the basic Electrochemistry that occurs in batteries for Hybrid Electric Vehicles.

UNIT I INTRODUCTION   9
Electric and hybrid vehicles, flexible fuel vehicles (FFV), solar powered vehicles, magnetic track vehicles, fuel cells vehicles.

UNIT II POWER SYSTEM AND NEW GENERATION VEHICLES   9
Hybrid Vehicle engines, Stratified charge engines, lean burn engines, low heat rejection engines, hydrogen engines, HCCI engine, VCR engine, surface ignition engines, VVTI engines. High energy and power density batteries, fuel cells, solar panels, flexible fuel systems.

UNIT III VEHICLE OPERATION AND CONTROL   9
Computer Control for pollution and noise control and for fuel economy – Transducers and actuators - Information technology for receiving proper information and operation of the vehicle like optimum speed and direction.

UNIT IV VEHICLE AUTOMATED TRACKS   9
Preparation and maintenance of proper road network - National highway network with automated roads and vehicles - Satellite control of vehicle operation for safe and fast travel GPS.

UNIT V SUSPENSION, BRAKES, AERODYNAMICS AND SAFETY   9
Air suspension – Closed loop suspension, compensated suspension, antiskid braking system, retarders, regenerative braking, safety gauge air backs- crash resistance. Aerodynamics for modern vehicles, safety systems, materials and standards.

                                                      TOTAL: 45 Hours

Text Books:
1. Hainz, "Modern Vehicle Technology" Second Edition,EU.
2. Bosch Hand Bok, SAE Publication, 2000.

Reference Books:
1. Light weight electric for hybrid vehicle design.
2. Advance hybrid vehicle power transmission, SAE.
3. Noise reduction, Branek L.L., McGraw Hill Bok Company, New York, 1993

Weblinks:
* https://nptel.ac.in/courses
* https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Justify Electric & hybrid vehicles, Solar Powered and fuel cells vehicles	K3
CO2:	Illustrate High Energy and Power density batteries, Solar Panels and Flexible Fuel systems.	K3
CO3:	Explain Satellite control of vehicle operation for safe, GPS and fast travel.	K4
CO4:	Criticize closed loop, Compensated types of Suspension and Braking system	K5
CO5:	State aerodynamics, safety system and its standards for modern vehicles	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22PEAU21	AUTOMOTIVE AIR-CONDITIONING	L	T	P	Credits
		3	0	0	3

Course Objective:

> To study the components of the automotive air-conditioning and their functions.
> To familiarize with latest developments in this field.

UNIT I AIR CONDITIONING FUNDAMENTALS   9

Basic air conditioning system - location of air conditioning components in a car; schematic layout of a refrigeration system, compressor components, condenser and high pressure service ports, thermostatic expansion valve, expansion valve calibration, controlling evaporator temperature, evaporator pressure regulator, evaporator temperature regulator.

UNIT II AIR CONDITIONER – HEATING SYSTEM   9

Automotive heaters, manually controlled air conditioner, heater system, automatically controlled air conditioner and heater systems, automatic temperature control, air conditioning protection, engine protection.

UNIT III REFRIGERANT   9

Containers handling refrigerants, tapping into the refrigerant container, refrigeration system diagnosis, diagnostic procedure, ambient conditions affecting system pressures.

UNIT IV AIR ROUTING AND TEMPERATURE CONTROL   9

COURSE OBJECTIVEs, evaporator airflow through the recirculation unit, automatic temperature control, duct system, controlling flow, vacuum reserve, testing the air control and handling systems.

UNIT V AIR CONDITIONING SERVICE   9

Air conditioner maintenance and service, servicing heater system removing and replacing components, trouble shooting of air controlling system, compressor service.

                                                         TOTAL: 45 Hours

TEXT BOOKS:

1. William H. Crouse and Donald I. Anglin - "Automotive Air conditioning" - McGraw Hill - 1990.
2. Boyce H.DWiggins - "Automotive Air Conditioning" - Delmar – 2002.

REFERENCE BOOKS:

1. Mitchell information Services, Inc - "Mitchell Automatic Heating and Air Conditioning Systems" - Prentice Hall Ind. -   1989.
2. Paul Weiser - "Automotive Air Conditioning" - Reston Publishing Co., Inc. - 1990.
3. MacDonald, K.L. - "Automotive Air Conditioning" - Theodore Audel series - 1978.
4. Goings L F – "Automotive Air Conditioning" - American Technical services - 1974.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	List and explain the air conditioning components.	K3
CO2:	Clearly explain the air conditioning protection.	K3
CO3:	Familiar with the handling refrigerants & diagnostic procedure	K4
CO4:	Describe the ambient conditions affecting system pressures	K5
CO5:	Clearly explain the air conditioner maintenance and service.	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

PO—	PO 1	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
CO 1	3	2	1	1	2	-	2	-	-	1	-	-	3	3
CO 2	3	2	-	1	2	1	2	-	1	-	-	1	3	3
CO 3	3	2	-	-	2	-	2	-	-	-	-	-	3	1
CO 4	3	3	3	2	3	2	2	2	1	2	3	3	1	3
CO 5	3	2	1	2	2	1	3	1	-	2	1	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓	✓	✓

22PEAU22	AUTOMOTIVE TESTING	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To introduce the learners with the need for automotive testing methods and their importance.

➤ To equip them with knowledge in various testing standards and guidelines.

UNIT I VEHICLE WIND TUNNEL TESTING ANDBODYTESTING 10

Wind tunnel test requirements - Ground boundary simulation - wind tunnel selection and Reynolds number capability, model details, mounting of model, Test procedure, Body test - Dynamics simulation sled testing - Dolly roll over test - Dolly roll over fixture - vehicle roof strength test - Door system crash test.

UNIT II COLLISION AND CRASHTESTING 9

Crash testing, Human Testing, Dummies, Crash worthiness, pole crash testing, rear crash testing, vehicle to vehicle impact, side impact testing, crash test sensor, sensor mounting positions, crash test data acquisition, braking distance test

UNIT III TESTING OF WHEELSANDBRAKES 10

Wheels: Dynamic cornering fatigue, dynamic radial fatigue tests-procedures, bending moment and radial load calculation. Impact test -Road hazard impact test for wheel and tyre assemblies test procedures, Failure criteria and performance criteria.

UNIT IV ENERGY AND FUELCONSUMPTIONTESTING 7

Engine cooling fan, air conditioning and brake compressor, hydraulic pumps power consumptions, ABS energy consumption. Test Route selection, vehicle test speeds, cargo weights, driver selection. Tested data, finding and calculations. Test on rough terrain, Pot hole with laden and unladen conditions.

UNIT V VEHICLE COMPONENTRELATEDTESTING 9

Reading - longer texts - close reading, writing - brainstorming - writing short essays - developing an outline - identifying main and subordinate ideas - dialogue writing, Listening - listening to talks - conversations, Speaking - participating in conversations - short group conversations, Language development -modal verbs-present post perfect tense. Vocabulary development - collocations.

TOTAL: 45 Hours

TEXT BOOKS:

1. Bosch - "Automotive Handbook" - 5th edition - SAE publication - 2000.

REFERENCE BOOKS:

1. Beck with, T.G. and Buck, N.L. "Mechanical Measurements", Addition Wesley publishing company Limited, 1995.
2. SAE Hand book, Vol.3, SAE, Publications,2000
3. Tim Grilles, "Automotive Service" Delmar publishers,1998

4. W.H. course& D.L. Anglin, "Automotive Mechanics" TMG publishing company, 2004

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Prepare the vehicle for testing according to standards	K3
CO2:	Test the vehicle in static and dynamic conditions	K3
CO3:	Incorporate all the automotive testing regulations while testing vehicle	K4
CO4:	Test on effectiveness and efficiency of all the components	K5
CO5:	Analyze the vehicle and report the results	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	-	1	3	2	-	3	3	2
CO2	1	3	2	3	-	3	3	3	-	3	3	3
CO3	3	3	3	3	-	1	3	3	-	3	3	3
CO4	3	2	3	3	-	-	1	2	-	3	3	1
CO5	2	2	2	3	-	1	1	2	-	3	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓	✓	✓

		L	T	P	Credits
22GEAU01	COMPUTER INTEGRATED MANUFACTURING SYSTEMS	3	0	0	3

Course Objective:

➤ To develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.

UNIT I COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing the facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wireframe modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

UNIT II COMPONENTS OF CIM 9

CIM as a concept and technology, CASA/SME model of CIM, CIM-II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven-layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM.

UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

History Of Group Technology – the role of G.T in CAD CAM Integration – part families-classification and coding – DCLASS and M-CLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing. Process planning - the role of process planning in CAD CAM Integration – approaches to computer-aided process planning – variant approach and generative approaches – CAPP and CMPP systems.

UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS 9

Shop floor control – phases – factory data collection system – automatic identification methods – Bar code technology – automated data collection system.

FMS – components of FMS – types – FMS workstation – material handling and storage system –FMS layout- computer control systems – applications and benefits.

UNIT V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING 9

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – shop floor control Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

TOTAL: 45 hours

Text Book:
1. Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2001

Reference Books:
1. Mikell P. Groover and Emory Zimmers Jr., "CAD/CAM", Prentice-Hall of India Pvt. Ltd., 1998

2. James A. Rzgh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
3. Yoram Koren, "Computer Integrated Manufacturing", McGraw Hill, 2005.
4. P N Rao, "CAD/CAM Principles and Applications", TMH Publications, 2007.

Web Links:
1. https://nptel.ac.in/courses
2. https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Describe the fundamental theoretical concepts governing fluid power	K3
CO2:	Ability to formulate the mathematical models of hydraulic and pneumatic circuits	K3
CO3:	Identify the common hydraulic and pneumatic components	K4
CO4:	Describe the working principle of pneumatic cylinders and motors.	K5
CO5:	Analyze the pneumatic circuits by considering the possible failures.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 2	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO 3	1	2	1	2	1	-	-	-	-	-	-	-	1	2
CO 4	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO 5	1	2	2	2	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22GEAU02	HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	Credits
		3	0	0	3

Course Objective:
➤ To Design and understand the electro-hydraulic and electro-pneumatic circuits

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS   12

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM & COMPONENTS   12

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic, Cushioning mechanism, Construction of double-acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

UNIT III HYDRAULIC CONTROL AND CIRCUITS   12

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 – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types and sizing of accumulators – intensifiers – Applications of Intensifiers. Circuits for controlling single acting and double acting cylinders, Accumulators circuits – Intensifier circuit.

UNIT IV PNEUMATIC CONTROL AND CIRCUITS   12

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, quick exhaust valves, and pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V SERVO SYSTEMS, FLUIDICS AND FLUID POWER TROUBLE SHOOTING   12

Servo systems – Hydro Mechanical servo systems, Electro-hydraulic servo systems and proportional valves, Fluidics – Introduction to fluidic devices, simple circuits. Introduction to Electro-Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting

TOTAL: 60 hours

Text Books:
1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2000
2. Majumdar S.R., "Oil Hydraulics", Tata McGraw-Hill, 2000.

Reference Books:

1. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
2. Anthony Lal, "Oil hydraulics in the service of industry", Allied Publishers, 1982.
3. Harry L. Stewart D.B, "Practical guide to fluid power", Taraceala sons and Port Ltd. Broadey, 1976.
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice-Hall, 1989.
5. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice-Hall, 1987.

Web Links:
1. https://nptel.ac.in/courses
2. https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Describe the fundamental theoretical concepts governing fluid power	K3
CO2:	Ability to formulate the mathematical models of hydraulic and pneumatic circuits	K3
CO3:	Identify the common hydraulic and pneumatic components	K4
CO4:	Describe the working principle of pneumatic cylinders and motors.	K5
CO5:	Analyze the pneumatic circuits by considering the possible failures	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO 1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO 2	3	3	1	2	3	-	-	-	-	-	-	-	3	3
CO 3	2	1	2	5	2	-	-	-	-	-	-	-	2	1
CO 4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO 5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22GEAU03	DESIGN OF MACHINE ELEMENTS	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To understand the principle involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements

➤ To learn to use standard practices and standard data

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS   9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS   9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS   9

Threaded fastners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS   9

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT V BEARINGS   9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Somerfield Number, Raimondi and Boyd graphs, – Selection of Rolling Contact bearings.

TOTAL: 45 Hours

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill 2011

REFERENCE BOOKS:

1. Alfred Hall, Halowenko, A and Laughlin,H, "Machine Design", Tata McGraw-Hill Book Co, (Schaum's Outline), 2010

2. Ansel Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.
3. R.C Gope, "Machine Design – Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. Sundararamoorthy T.V Shanmugam N, "MachineDesign" Anuradha Publications, Chennai, 2015.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Explain the influence of steady and variable stresses in machine component design.	K3
CO2:	Apply the concepts of design to shafts, keys and couplings.	K3
CO3:	Apply the concepts of design to temporary and permanent joints.	K4
CO4:	Apply the concepts of design to energy absorbing members, bearings and connecting rod.	K5
CO5:	Apply the concepts of design to bearings.	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

PO –	PO 1	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
CO1	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO2	3	2	1	2	2	-	-	-	-	-	-	-	3	2
CO3	2	3	2	2	2	-	-	-	-	-	-	-	2	2
CO4	3	1	2	2	3	-	-	-	-	-	-	-	3	1
CO5	2	2	1	2	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22GEAU04	WASTE HEAT RECOVERY AND CO-GENERATION	L	T	P	Credits
		3	0	0	3

Course Objective:

> To understand the waste heat recovery systems, economic analysis and environmental considerations.

UNIT I INTRODUCTION 9

Source and utilization of waste heat, thermodynamic analysis - Second law and waste heat, Recovery of waste heat engines and other power plants –Heat pump for waste heat recovery.

UNIT II DESIGN OF WASTE HEAT RECOVERY SYSTEMS 9

Design of waste heat recovery system - Heat exchanger - Theory and design, Organic fluid systems – Analysis and design.

UNIT III COGENERATION PRINCIPLES 9

Cogeneration principles and thermodynamics power cycle analysis, combined for power generation and process heat.

UNIT IV APPLICATIONS OF COGENERATION 9

Applications in sugar mills rice mills, textile factories, and other process and engineering industries.

UNIT V COST ANALYSIS OF COGENERATION SYSTEMS 9

Financial considerations, operating and maintenance cost, investment costs of waste heat recovery and Cogeneration system, environmental and air quality consideration.

TOTAL: 45 Hours

Text Books:
1. Charles H.Butler, "Cogeneration ", Mc Graw Hill Book Co., 1984.
2. Goldstick R., et.al, "Principles of Waste Heat Recovery ", The Fairment Press, Inc., Georgia, 1986

Reference Books:
1. Kiang Y.H., "Waste Utilization Technology ", Marcel Dekker Inc., 1981.
2. David Hu and Gerald Hrd, "Waste recycling for Energy Conservation ", John Wiley and Sons, New York, 1981.
3. Sydney Reiter, " Industrial and Commercial Heat Recovery Systems ", Van Nostrand Reinhold, 1985.

4 Spiewak Scott A, "Cogeneration and Small Power Production Manual", the Fairmont Press, 1987.

5. Nelson E. Hay, "Guide to Natural Gas Cogeneration", The Fairmont Press Inc., 1980.

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Define the utilization of waste heat, second law and thermodynamic analysis of waste heat.	K3
CO2:	Resolve the theory, design and analysis of waste heat recovery systems and organic fluid systems	K3
CO3:	Evaluate the Cogeneration principles and thermodynamic power cycle analysis	K4
CO4:	Derive the power generation and process heat in waste heat process	K5
CO5:	Determine the Financial Considerations of Waste heat Recovery system	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	-	3	2	-	2	2	2
CO2	3	2	2	2	3	-	3	1	-	1	1	2
CO3	3	3	3	2	3	-	3	3	-	3	2	2
CO4	3	3	3	3	1	-	3	3	-	3	1	3
CO5	2	3	3	3	2	-	3	3	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22GEAU05	DESIGN AND ANALYSIS OF COMPOSITES	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ Study about linear elastic analysis of composite materials.

➤ To understand the anisotropic material behavior

UNIT I COMPOSITE MATERIALS AND THEIR APPLICATIONS 9

Introduction Fibers Matrix materials Material forms and fabrication methods Current applications

UNIT II CONCEPTS OF SOLID MECHANICS 9

Tensors Stress and strain Plane stress and plane strain energy density Generalized Hooke's Law Material symmetry Engineering constants 3 Coordinate transformations Thermal effects, Moisture effects Chemical aging, flammability

UNIT III CONCEPTS OF MICROMECHANICS 9

Effective properties Survey and model comparison from strength of materials approximations, continuum mechanics approaches

UNIT IV STRESS-STRAIN FOR AN ORTHOTROPIC LAMINA AND LAMINATE ANALYSIS 9

Orthotropic properties in plane stress, Deformation due to extension shear and bending torsion A, B, D matrices hydrothermal behavior Special laminates Average stress-strain properties

UNIT V CONCEPTS OF FAILURE OF LAMINATES AND SHAFTS 9

Tensile failure of fiber composites Compressive failure of fiber composites Effect of multi axial stresses (failure criteria by Tsai-Wu, Hashin, etc.) Edge effects, Effective stiffness of beams Effective stiffness of shafts.

TOTAL: 45 Hours

TEXT BOOKS:

1. Carl T. Herakovich, Mechanics of Fibrous Composites, 1997.

2. Stephen R. Swanson, Introduction to Design and Analysis with Advanced Composite Materials, Prentice-Hall, 1997.

REFERENCE BOOKS:

1. HyerM. W., Stress Analysis of Fiber-Reinforced Composite Materials, McGraw-Hill, 1997

2. GibsonR. F., Principles of Composite Material Mechanics, 2nd edition, CRC Press

Weblinks:

* https: nptel.ac.in courses
* https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Explain the applications of Matrix materials.	K3
CO2:	Explain the Moisture effects	K3
CO3:	Describe the properties of micromechanics.	K4
CO4:	Describe the properties in plane stress.	K5
CO5:	Explain the effective stiffness of shafts.	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	1	3	2	-	2	3	2
CO2	3	3	3	3	3	1	3	3	-	3	1	3
CO3	3	3	3	3	3	1	3	3	-	3	3	3
CO4	3	3	3	3	3	1	3	3	-	3	3	2
CO5	3	3	3	3	3	1	1	2	-	3	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22GEAU06	COMPUTATIONAL FLUID DYNAMICS	L	T	P	Credits
		3	0	0	3

Course Objective:

> To introduce numerical modeling and to solve complex problems in the field of heat transfer and fluid flow.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS   9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent flow - Turbulence -Kinetic - Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES   9

Methods of Deriving the Discretization Equations - Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method. Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III HEAT CONDUCTION   9

Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problem

UNIT IV CONVECTION AND DIFFUSION   9

Finite volume formulation of steady one-dimensional convection and Diffusion problems; Central, upwind, hybrid and power-law schemes - Discretization equations for two dimensional convection and diffusion.

UNIT V CALCULATION OF FLOW FIELD   9

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. Turbulence models: mixing length model, two equation (k-ε) models.

TOTAL: 45 Hours

TEXT BOOKS:
1. Versteeg, H.K, and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Longman, 1998
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw- Hill Publishing Company Ltd., 1998.

REFERENCE BOOKS:

1. Patankar, S.V., "Numerical Heat Transfer and Fluid Flow", McGraw-Hill, 1980. Ane-Books 2004 Indian Edition.
2. Muralidhar, K and Sundararajan, T. "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
3. Bose, T.K., "Numerical Fluid Dynamics", Narosa publishing House, 1997.
4. Muralidhar, K and Biswas "Advanced Engineering Fluid Mechanics", Narosa Publishing House, New Delhi, 1996.
5. Anderson, J.D., "Computational fluid dynamics – the basics with applications", 1995.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Demonstrate the ability to use modern CFD software tools	K3
CO2:	Demonstrate the ability to analyze the flow visualization and analysis tools.	K3
CO3:	Ability to simplify a real fluid-flow system into a simplified model problem	K4
CO4:	Ability to communicate the results of this detailed fluid-flow study	K5
CO5:	Describe the mathematical properties of governing Navier-Stokes equations	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	1	3	2	–	2	3	2
CO2	2	3	3	3	2	1	1	2	–	2	1	2
CO3	2	2	3	3	3	1	3	3	–	3	3	2
CO4	3	2	3	3	3	1	3	3	–	3	3	3
CO5	2	3	3	3	2	1	3	2	–	3	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓

Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
		✓	✓		✓

		L	T	P	Credits
22GEAU07	METROLOGY AND INSTRUMENTATION	3	0	0	3

Course Objective:

> This course provides required knowledge, skills and creates self confidence in students so that they can work on shop floor independently for accurate and precise measurements and manufacturing.

UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS   9

Sensors: Functions- Classification- Main technical requirement and trends Units and standards- Calibration methods- Classification of errors- Error analysis- Limiting error- Probable error- Propagation of error- Odds and uncertainty- principle of transduction- Classification. Static characteristics- mathematical model of transducers- Zero, First and Second order transducers- Dynamic characteristics of first and second order transducers for standard test inputs.

UNIT II VARIABLE RESISTANCE AND INDUCTANCE SENSORS   9

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezo resistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pickup and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS   9

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magneto strictive, Hal Effect, semiconductor sensors- digital transducers- Humidity Sensor, Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

UNIT IV AUTOMOTIVE PRESSURE AND FORCE/TORQUE SENSOR   9

Pressure Sensor: Typical automotive applications- Thick film pressure sensor- Semiconductor pressure sensor Integrated silicon intake-manifold pressure sensor-Integrated silicon combustion-pressure sensor- Piezo electric sensor-High pressure sensor with metal diaphragm Force/Torque Sensor: Typical automotive applications- Magneto elastic bearing-pin sensor- Magneto elastic tension/compressive-force sensor according to the cross-ductor principle – Basic principle of torque measurement –Stress and Angle measuring torque sensor

UNIT V AUTOMOTIVE POSITION AND RPM/VELOCITY SENSORS   9

Position Sensors:- Typical automotive applications- Wiper potentiometers- Short-circuiting ring sensor- Half-differential sensor- Eddy-current pedal-travel sensor- Integrated Hal IC's – Hal acceleration sensor- Knock sensors-RPM and Velocity Sensors: - Inductive rotational sped sensor- Hal effect sensor Temperature Sensors:- Typical automotive applications - Sintered-Ceramic resistors-Thin film resistors-Thick film resistors- Mono crystalline silicon semiconductor resistor- Thermopile sensors Flow Sensors:- Ultrasonic flow sensors-Pitot tube air-flow sensor- Hot wire air-mass flow meter- Micro mechanical hot-film air-mass flow meter-Lambda sensor –Imaging sensor-Rain Sensor Introduction to MEMs

TOTAL: 45 Hours

TEXT BOOKS:
1. Doeblin E.O, "Measurement Systems: Aplications and Design", 5th Editon, Tat McGraw-Hil Publishing Co, 2007

2. Robert Brandy, "Automotive Electronics and Computer System", Prentice Hall, 2001
3. William Kimberley," Bosch Automotive Handbook", 6th Edition, Robert Bosch GmbH, 2004

REFERENCE BOOKS:
1. Bentley J.P," Principles of Measurement Systems", 4th Edition, Adission Wesley Longman Ltd., U.K, 2004.
2. Patranabis D, "Sensors and Transducers", 2nd Edition, Prentice Hall India Ltd, 2003.
3. Murthy D.V.S, "Transducers and Instrumentation", Prentice Hall of India, 2007.

Weblinks:

* https: nptel.ac.in courses
* https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Identify the methods of vibration and noise measurement	K3
CO2:	Compare the effect of noise on human comfort and environment	K3
CO3:	Describe the concept of mufflers, tire road noise.	K4
CO4:	Describe the interior transportation noise and vibration sources.	K5
CO5:	Describe the various noise and vibration measurements.	K5

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	3	-	1	3	2	-	3	3	2
CO2	2	3	2	3	-	1	3	3	-	3	1	2
CO3	3	3	3	3	-	1	3	2	-	3	2	2
CO4	3	2	3	3	-	1	1	2	-	3	3	1
CO5	2	2	2	3	-	1	1	2	-	3	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓	✓	✓

22GEAU08	COMPOSITE MATERIALS & STRUCTURES	L	T	P	Credits
		3	0	0	3

Course Objective:

> To understand the fabrication, analysis and design of composite materials & structures

UNIT I INTRODUCTION TO COMPOSITES 8

Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Applications of various types of composites.

UNIT II POLYMER MATRIX COMPOSITES 12

Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding – Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

UNIT III METAL MATRIX COMPOSITES 9

Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements – particles – fibres. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process – diffusion bonding – stir casting – squeeze casting.

UNIT IV CERAMIC MATRIX COMPOSITES 9

Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

UNIT V ADVANCES IN COMPOSITES 7

Carbon/carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

TOTAL: 45 Hours

TEXT BOOKS:
1. Mathews F.L. and Rawlings R.D., "Composite materials: Engineering and Science", Chapman and Hall, London, England, 1st edition, 1994.
2. Chawla K.K., "Composite materials", Springer – Verlag, 1987.

REFERENCE BOOKS:

1. Clyne T.W. and Withers P.J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma S.C., "Composite materials", Narosa Publications, 2000.
4. "Short Term Course on Advances in Composite Materials, Composite Technology Centre, Department of Metallurgy", IIT-Madras, December 2001

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Explain the fundamentals of composites.	K3
CO2:	Familiar with the thermoplastic resins.	K3
CO3:	Explain the Metal matrix composites Alloy.	K4
CO4:	Describe the diffusion bonding	K5
CO5:	Describe study of engineering ceramic materials	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	2	2	2	2	3	2
CO3	3	2	2	2	-	-	-	-	3	3	2	3	2	2
CO4	3	2	2	3	-	-	-	-	3	2	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22GEAU09	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	Credits
		3	0	0	3

Course Objective:

> To understand the functions and design principles of Jigs, fixtures and press tools.

UNIT I LOCATING AND CLAMPING PRINCIPLES 8

Tool design- Function and advantages of Jigs and fixtures – Basic elements- principles of location – Locating methods and devices – Redundant Location –Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES 10

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND CUTTING DIES 10

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots –Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies

UNIT IV BENDING FORMING AND DRAWING DIES 10

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for ax- symmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V MISCELLANEOUS TOPICS 7

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke - Course should be supplemented with visits to industries.

(Use of Approved design Data Book permitted)

TOTAL: 45 Hours

TEXT BOOKS:
1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004
2. Donaldson, Lecain and Goold "Tool Design", IIIrd Edition Tata McGraw Hill, 2000

REFERENCE BOOKS:

1. K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005 Kempster, "Jigs and Fixture Design", Hodden and Stoughton – Third Edition 1974.
2. Joshi, P.H. "Press Tools" – Design and Construction", Wheels publishing, 1996.
3. Hoffman "Jigs and Fixture Design" – Thomson Delmar Learning, Singapore, 2004.
4. ASTME Fundamentals of Tool Design Prentice Hall of India.
5. Design Data Hand Book, PSG College of Technology, Coimbatore.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Explain the basics of Jigs and fixtures	K3
CO2:	Explain the different types of Fixtures and Gauges	K3
CO3:	Explain the construction and working principles of different types of press and press tools	K4
CO4:	Describe the Manufacture and assemble of different press tools	K5
CO5:	Ability to classify and explain various press tools and press tools operations.	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	2	2	2	2	3	2
CO3	3	2	2	2	-	-	-	-	2	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	2	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation
			✓	✓

22GEAU10	ROBOTICS	L	T	P	Credits
		3	0	0	3

Course Objective:

- To understand the basic concepts associated with the design and functioning and applications of Robots
- To study about the drives and sensors used in Robots

UNIT I FUNDAMENTALS OF ROBOT 7

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C.Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 10

Requirements of a sensor, Principles and Applications of the following types of sensors– Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors).Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis –Data Reduction: Edge detection, Segmentation Feature Extraction and Object Recognition – Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming. Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

TOTAL: 45 Hours

TEXT BOOK:
1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001

REFERENCE BOOKS:
1. Fu K.S. Gonzals R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
3. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Classify the robots based on joints and arm configurations	K3
CO2:	Program robot to perform typical tasks including Pick and Place, Stacking and Welding.	K3
CO3:	Design and select robots for Industrial and Non-Industrial applications	K4
CO4:	Describe the automation and brief history of robot and applications	K5
CO5:	Describe the Programming methods & various Languages of robots.	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22GEAU11	SUPERCHARGING AND SCAVENGING	L	T	P	Credits
		3	0	0	3

Course Objective:

> To make the students understand the need for supercharging and the various types of superchargers used and their performance characteristics and the scavenging methods for two stroke engines.

UNIT I SUPERCHARGING   8

Effects on engine performance – engine modification required Thermodynamics of Mechanical Supercharging and Turbocharging – Turbocharging methods – Engine exhaust manifolds arrangements.

UNIT II SUPERCHARGERS   10

Types of compressors – Positive displacement blowers – Centrifugal compressors – Performance characteristic curves – Suitability for engine application – Surging –Matching of supercharger compressor and Engine – Matching of compressor, Turbine, Engine

UNIT III SCAVENGING OF TWO STROKE ENGINES   12

Peculiarities of two stroke cycle engines – Classification of scavenging systems –Mixture control through Reed valve induction – Charging Processes in two stroke cycle engine – Terminologies – Shankey diagram – Relation between scavenging terms –scavenging modeling – Perfect displacement, Perfect mixing – Complex scavenging models.

UNIT IV PORTS AND MUFFLER DESIGN   8

Porting – Design considerations – Design of Intake and Exhaust Systems – Tuning

UNIT V EXPERIMENTAL METHODS   7

Experimental techniques for evaluating scavenging – Firing engine tests – Non firing engine tests – Port flow characteristics – Kadenary system – Orbital engine combustion system.

TOTAL: 45 Hours

TEXT BOOKS:
1. Watson, N. and Janota, M.S., Turbocharging the I.C Engine, MacMillan Co., 1982.
2. John B.Heywood, Two Stroke Cycle Engine, SAE Publications, 1997.

REFERENCE BOOKS:
1. Obert, E.F. Internal Combustion Engines and Air Pollution, Intext EducationalPublishers, 1980.
2. Richard Stone, Internal Combustion Engines, SAE, 1992.
4. Schweitzer, P.H., Scavenging of Two Stroke Cycle Diesel Engine, MacMillan Co., 1956

COURSE OUTCOMES:

CO1:	Describe the effects on Engine performance and Engine modification.	K3
CO2:	State the types of compressors, blowers and its Performance Characteristics Curves.	K3
CO3:	Define the peculiarities of two stroke Engines, and its Scavenging and Charging process.	K4
CO4:	Evaluate the design of Intake and Exhaust systems.	K5
CO5:	Determine the Experimental techniques for evaluating scavenging	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	1	2	1	-	-	1	-	1
CO2	3	3	1	1	2	-	-	-	-	1	-	2
CO3	2	1	3	2	1	3	3	2	-	2	1	1
CO4	2	-	1	1	1	3	2	1	-	2	2	1
CO5	2	1	1	1	1	2	0	-	-	1	-	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

		L	T	P	Credits
22GEAU12	MECHANICS OF MACHINES	3	0	0	3

Course Objective:

➢ To understand the different mechanisms, the method of working of different mechanisms

➢ To impart on knowledge on the Forces involved and consequent vibration during working

UNIT I KINEMATIC OF MECHANICS   9

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain –kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of flowers motion – circular arc and tangent cams

UNIT II GEARS and GEAR TRAINS   9

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

UNIT III FRICTION   9

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches – Belt and rope drives – brakes – Tractive resistance.

UNIT IV FORCE ANALYSIS   9

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 – super position principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND VIBRATION   9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration solution.

TOTAL: 45 Hours

TEXT BOOKS:
1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hal of India, New Delhi, 207
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", OxfordUniversity

REFERENCE BOOKS:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and A.K.Malick, "Theory and Machine", Afiliated East-West Pvt. Ltd., New Delhi, 198.
3. Rao J.S. andDukipati R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 192.
4. Ramamurthi V., "Mechanisms of Machine", Narosa Publishing House, 202.
5. Robert L.Norton, "Design of Machinery", McGraw-Hill, 204.

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov in

COURSE OUTCOMES:

CO1:	Analyze the different types of motions and Displacement diagram of Cam and Follower	K3
CO2:	Discuss about the Frictional forces in an Inclined Planes, Screw threads and Clutches.	K3
CO3:	Analyze the Tensions, Forces and Power in different types of Belt and Rope drives and Brakes.	K4
CO4:	Compare the Dynamic Force analysis, inertial force and Torque in Simple Machine Members.	K5
CO5:	Evaluate the Free vibrations, balancing of revolving and reciprocating masses of rotating shaft	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	2	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓	✓	✓

22OEAU01	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	Credits
		3	0	0	3

Course Objective:

➢ To enable the students to study the evolution of Management, to study the functions and principles of management and to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I OVERVIEW OF MANAGEMENT   9

Definition - Management - Role of managers - Evolution of Management thought – Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

UNIT II PLANNING & ORGANIZING   9

Nature and purpose of planning and Organizing - Planning process - Types of plans – Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions - Organization structure - Formal and informal groups I organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal

UNIT III DIRECTING & CONTROLLING   9

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication – Organization Culture - Elements and types of culture - Managing cultural diversity Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

UNIT IV ENGINEERING ETHICS & HUMAN VALUES   9

Definition - Societies for engineers – Code of Ethics – Ethical Issues involved in cross border research - Ethical and Unethical practices – case studies – situational decision making - Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT V SAFETY RESPONSIBILITIES AND RIGHTS   9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination – Global issues - Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisers – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 Hours

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, 2007.

REFERENCE BOOKS:
1. Hellriegel, Slocum & Jackson, 'Management - A Competency Based Approach', Thomson South Western, 2007.
2. Andrew J Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.

Weblinks:

* https://nptel.ac.in/courses
* https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Define management, managers role and management challenges	K3
CO2:	Explain planning, organizing, decision making, delegation, staffing and recruitment	K3
CO3:	Describe the directing and controlling functions	K4
CO4:	Explain the engineering ethics and human values	K5
CO5:	Describe the safety responsibilities and rights	K3

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	1	2	-	3	2	-	-	-	-	2
CO2	2	2	-	1	2	2	-	3	1	-	-	-	-	2
CO3	2	1	-	2	1	1	-	3	1	-	-	-	-	2
CO4	2	2	-	2	2	2	-	3	1	-	-	-	-	2
CO5	2	1	-	2	2	2	-	3	1	-	-	-	-	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22OEAU02	TOTAL QUALITY MANAGEMENT	L	T	P	Credits
		3	0	0	3

Course Objective:

➤ To facilitate the understanding of Quality Management principles and process

UNIT I INTRODUCTION   9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM

UNIT II TQM PRINCIPLES   9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I   9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II   9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS   9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL: 45 Hours

TEXT BOOK:
1. Dale H. Besterfiled, etc at "Total Quality Management", Pearson Education Asia, Third Edition, 2006.

REFERENCE BOOKS:
1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
3. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd.

4. R. Pugazhenthi, A. Baradeswaran, K. Balachandran, and P. Balamurali "Total Quality Management", sams publications, 2015.

4. R. Pugazhenthi, A. Baradeswaran, K. Balachandran, and P. Balamurali "Total Quality Management", sams publications, 2015.

Weblinks:

- https: nptel.ac.in/courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Define quality, concepts of quality and TQM	K3
CO2:	Explain in detail about the TQM principles	K3
CO3:	Describe the various tools and techniques of TQM	K4
CO4:	Define quality circle and performance measures	K5
CO5:	List the quality systems implemented in manufacturing and service sectors including IT.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	PO 1	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
CO 1	3	3	1	2	2	-	-	-	-	-	-	-	3	3
CO 2	2	3	1	1	1	-	-	-	-	-	-	-	2	3
CO 3	2	2	2	1	2	-	-	-	-	-	-	-	2	2
CO 4	3	2	1	2	1	-	-	-	-	-	-	-	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22OEAU03	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	Credits
		3	0	0	3

Course Objective:

> To be familiar with the various quality control techniques and control charts for variables and attributes

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES   9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance Quality control Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for chart -process capability – process capability studies-variables – X chart, R chart and simple problems, Six sigma concepts.

UNIT II PROCESS CONTROL FOR ATTRIBUTES   9

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING   9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C curves – producer's Risk and consumer's Risk AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY   9

Life testing – Objective – failure data analysis, Mean failure rate, means time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability –simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY   9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Note: *Use of approved statistical table permitted in the examination*

TOTAL: 45 Hours

TEXT BOOKS:

1. Douglas C.Montgomery, "Introduction to Statistical quality control", John wiley, 4th edition2001.
2. Srinath L.S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCE BOOKS:

1. John.S.Oakland "Statistical process control", Elsevier, 5th edition, 2005
2. Grant, Eugene L. "Statistical Quality Control", McGraw-Hill, 1996
3. Monohar Mahajan, "Statistical Quality Control", DhanpatRai& Sons, 2001
4. GuptaR.C., "Statistical Quality control", Khanna Publishers, 1997
5. Besterfield D.H., "Quality Control", Prentice Hall, 1993.

Weblinks:

- https nptel.ac.in courses
- https swayam.gov.in

COURSE OUTCOMES:

CO1:	Define quality control, quality assurance and control charts.	K3
CO2:	Describe the process control charts for attributes	K3
CO3:	Define sampling and it types.	K4
CO4:	Explain life testing, reliability, availability and maintainability	K5
CO5:	Describe the reliability design and techniques.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	1	1	1	-	-	-	-	-	-	-	2	1
CO 2	1	2	2	2	1	-	-	-	-	-	-	-	1	2
CO 3	2	2	1	1	2	-	-	-	-	-	-	-	2	-
CO 4	1	1	2	2	1	-	-	-	-	-	-	-	1	1
CO 5	1	2	2	1	2	-	-	-	-	-	-	-	2	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

		L	T	P	Credits
22OEAU04	SUPPLY CHAIN MANAGEMENT	3	0	0	3

Course Objective:

> To be familiar with the various concepts and functions of supply chain management

UNIT I INTRODUCTION 9

Definition of Logistics and SCM: Evolution, Scope, Importance& Decision Phases – Drivers of SC Performance and Obstacles

UNIT II LOGISTICS MANAGEMENT 9

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis.

UNIT III SUPPLY CHAIN NETWORK DESIGN 9

Distribution in Supply Chain – Factors in Distribution network design –Design options- Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety

UNIT IV SOURCING, AND PRICING IN SUPPLY CHAIN 9

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain.

UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN 9

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work, E Business & SCM, Metrics for SC performance –Case Analysis.

TOTAL: 45 Hours

TEXT BOOKS:

1. Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra and Peter Meindl- PHI, Second edition, 2007
2. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, PHI 2002

REFERENCE BOOKS:

1. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition.
2. Modeling the supply chain, Jeremy F Shapiro, Thomson Duxbury, 2002

3. Handbook of Supply chain management, James B Ayers, St Lucie Press, 2000.

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Define logistics and supply chain management	K3
CO2:	Describe the modes of transportation and warehouse management	K3
CO3:	Explain the supply chain network design, managing cycle inventory and safety	K4
CO4:	Describe the sourcing and pricing in the SCM	K5
CO5:	Explain in detail about coordination and technology in the SCM	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO 1	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
CO 1	1	2	2	1	1	-	-	-	-	-	-	-	1	2
CO 2	3	1	3	2	1	-	-	-	-	-	-	-	3	1
CO 3	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	3	1	1	1	1	-	-	-	-	-	-	-	2	1
CO 5	3	1	1	2	3	-	-	-	-	-	-	-	2	3

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22OEAU05	OPERATIONS RESEARCH	L	T	P	Credit
		3	0	0	3

Course Objective:

➤ To be familiar with the optimization techniques under limited resources for the engineering

UNIT I LINEAR MODELS 9

The phase of an operation research study – Linear programming – Graphical method–
Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 9

Transportation Assignment Models –Traveling Salesman problem–Networks models –
Shortest route– Minimal spanning tree – Maximum flow models –Project network – CPM
and PERT networks –Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 9

Inventory models – Economic order quantity model – Quantity discount models – Stochastic
inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 9

Queueing models - Queueing systems and structures – Notation parameter – Single server
and multi-server models – Poisson input – Exponential service – Constant rate service –
Infinite population –Simulation.

UNIT V DECISION MODELS 9

Decision models – Game theory – Two person zero sum games – Graphical solution–
Algebraic solution– Linear Programming solution – Replacement models – Models based on
service life –Economic life– Single / Multi variable search technique – Dynamic
Programming – Simple Problem.

TOTAL: 45 Hours

TEXT BOOKS:
1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003

REFERENCE BOOKS:
1. Shenmoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley
Eastern,1994
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John
Wiley,1990
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986

5. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1980.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Define linear programming, simplex algorithm and sensitivity analysis	K3
CO2:	Explain the transportation assignment models and network models	K3
CO3:	Describe the various inventory model	K4
CO4:	Explain the queuing models, systems and structures	K5
CO5:	Describe the decision models and game theory	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	-	-	-	-	-	-	-	3	1
CO2	1	2	2	2	2	-	-	-	-	-	-	-	1	2
CO3	3	2	1	1	1	-	-	-	-	-	-	-	3	2
CO4	2	1	2	2	2	-	-	-	-	-	-	-	2	1
CO5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22OEAU06	ENERGY AUDIT AND ENERGY CONSERVATION METHODS	L	T	P	Credits
		3	0	0	3

Course Objective:

➢ This course provides the knowledge about energy audit and energy conservation methods in I.C. Engines.

UNIT I ENERGY AND ENVIRONMENT   9

Introduction - fossil fuels reserves - world energy consumption - greenhouse effect, global warming -Renewable energy sources - environmental aspects utilization - energy prices - energy policies.

UNIT II ENERGY CONSERVATION   9

Energy conservation schemes - industrial energy use - energy surveying and auditing - energy index –Energy cost - cost index - energy conservation in engineering and process industry, in thermal Systems, in buildings and non-conventional energy resources schema.

UNIT III ENERGY TECHNOLOGIES   9

Fuels and consumption - boilers - furnaces - waste heat recovery systems - heat pumps and Refrigerators - storage systems - insulated pipe work systems - heat exchangers.

UNIT IV ENERGY MANAGEMENT   9

Energy management principles - energy resource management - energy management information Systems - instrumentation and measurement - computerized energy management - energy Auditing.

UNIT V ECONOMICS AND FINANCE   9

Costing techniques - cost optimization - optimal target investment schedule - financial appraisal and Profitability - project management.

                                                         TOTAL- 45 Hours

TEXT BOOKS:

1. MurphyW.R. and McKay, "Energy Management, Butterworths, London, 1982.
2. TrivediP.R., JulkaB.R., "Energy Management", Common wealth publishers, 1997.

REFERENCE BOOKS:

1. David Merick, Richard Marshal, "Energy; present and future options", Vol. I and II, John Wiley and Sons, 1981.
2. Chaigier N.A. "Energy Consumption and Environment", McGraw-Hill 1981.
3. Ikkes P.A. Swart R.J and Zwerves S, "Climate and Energy ", 1989.
4. Ray D.A. "Industrial Energy Conservation ", Pergamon Press, 1980.

COURSE OUTCOMES:

CO1:	Describe the energy sources, utilization and policies	K3
CO2:	Explain the energy conservation in industries and buildings	K3
CO3:	Describe the various energy developing systems	K4
CO4:	Explain the energy management and auditing	K5
CO5:	Define the cost economics and optimization	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO—	PO 1	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
CO 1	1	2	3	3	2	-	-	-	-	-	-	-	1	2
CO 2	3	3	2	2	1	-	-	-	-	-	-	-	3	3
CO 3	2	2	1	1	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	2	2	3	-	-	-	-	-	-	-	2	1
CO 5	2	2	1	1	2	-	-	-	-	-	-	-	2	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22OEAU07	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	Credits
		3	0	0	3

Course Objective

➤ To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, objective.

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures- Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

TOTAL: 45 Hours

TEXT BOOKS:
1. Khanka, S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
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, "Entrepreneurship 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.

Weblinks:

- https: nptel.ac.in courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Define entrepreneur and it types	K3
CO2:	Explain motivation, self-rating and stress management	K3
CO3:	Describe the small enterprise and steps involved in setting up a business	K4
CO4:	Define the sources of finance, loans and taxation	K6
CO5:	Describe the government policies for small scale industries	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO 1	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
CO 1	3	2	2	3	1	-	-	-	-	-	-	-	3	2
CO 2	2	1	1	2	3	-	-	-	-	-	-	-	2	1
CO 3	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 4	1	1	1	1	3	-	-	-	-	-	-	-	1	1
CO 5	1	1	2	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
			✓		✓

22OEAU08	VALUE ANALYSIS AND VALUE ENGINEERING	L	T	P	Credits
		3	0	0	3

Course Objective:
> To provide the basic concepts and features of value analysis and value engineering.

UNIT I CONCEPTS   9

Introduction – status of VE in India and origin country – impact of VE application – types of values – types of function – function identification on product – function matrix – function analysis – elements of costs – calculation of costs – cost allocation to function – evaluation of worth in VE methodology.

UNIT II TECHNIQUES   9

General techniques: brain storming – gordon feasibility ranking – morphological analysis – ABC analysis – probability approach – make or buy.

UNIT III ANALYSIS   9

Function – cost-worth analysis – function analysis – system techniques – function analysis matrix – customer oriented FAST diagram – fire alarm – Langrange plan – evaluation methods – matrix in evaluation – break even analysis.

UNIT IV VALUE ENGINEERING IN JOB PLAN   9

Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase

UNIT V CASE STUDIES   9

Water treatment plant – engineering management; pump component; motor component; wet grinder; automobile hospital

TOTAL: 45 Hours

TEXT BOOKS:
1. Mukhophadhyaya A.K, "Value Engineering", Sage Publications Pvt. Ltd., New Delhi, 2003.
2. Richard J Park, "Value Engineering – A Plan for Inventions", St.Lucie Press, London, 1998.

REFERENCE BOOKS:
1. Larry W Zimmerman, P.E, "VE –A Practical Approach for Owners Designers and Contractors", CBS Publishers, New Delhi, 1992.
2. Arthus E Midge, "Value Engineering", McGraw Hill Inc., New York, 1971.
3. Army Materiel Command U.S, "Value Engineering (Engineering Design Handbook)", University Press of the Pacific, 2006

Weblinks:
- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Define value engineering and it types	K3
CO2:	Explain brain storming, morphological and ABC analysis	K3
CO3:	Describe the cost worth and function analysis, evaluation methods and break even analysis	K4
CO4:	Describe the value engineering in the different work phase	K5
CO5:	Illustrate the various case studies for value engineering and analysis	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	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
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	1	1	1	2	2	-	-	-	-	-	-	-	1	1
CO 3	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO 4	2	1	1	2	3	-	-	-	-	-	-	-	2	1
CO 5	3	2	1	1	2	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration / Presentation	Open book test
			✓		✓

22OEAU09	INDUSTRIAL MARKETING AND MARKET RESEARCH	L	T	P	Credits
		3	0	0	3

Course Objective:

> To be familiar with the newer concepts of marketing concepts like strategic marketing segmentation, pricing, advertisement and strategic formulation.

UNIT I INDUSTRIAL MARKETING 9

Nature of Industrial Marketing: Industrial Marketing Vs Consumer Marketing Relational approach to Industrial Marketing- The Nature of Industrial Demand &Industrial Customer Types of Industrial Products: Major Equipment, Accessory Equipment, Raw and Processed Materials, Component Parts and Sub- Assemblies, Operating Supplies, Standardized and Non-standardized parts, Industrial services.

UNIT II PRICING 9

Pricing for Industrial Products – Pricing COURSE OBJECTIVE - Price Decision Analysis – Breakeven analysis – net pricing – discount pricing – trade discounts – geographic pricing – factory pricing – freight allowance pricing – Terms of Sale – Outright purchase – Hire-purchase – Leasing

UNIT III MARKET RESEARCH 9

Introduction to Market Research, Types of Research – Basic & Applied, Nature, Scope, objective, Importance & Limitations of Market Research. Sources and collection of Marketing Data. Secondary data – Advantages &Limitations, Sources – Govt. & Non Govt. Primary Data – Advantages &Limitations, Sources Methods of Collection Primary Data – Observation, Mail, Personal Interview, Telephonic Interview, Internet Interviewing.

UNIT IV TECHNIQUES 9

Market Research Techniques: National readership survey, Retail Store Audit, Consumer Panels, Test Marketing, Research in Advertising Decisions, Marketing Audit, Data Base Marketing, Focus Group Interviews, Sampling Questionnaire & Scaling Techniques: Probability and Non Probability Sampling, Sampling methods, Sample Design, Questionnaire design and drafting, Scaling techniques like Nominal, Ordinal, Interval, Ratio, Perceptual Map, Semantic Differential, Likert, Rating& Ranking Scales.

UNIT V IMPLEMENTATION 9

Setting up & Implementation of Marketing Research Project, Steps in formulating Market Research Projects, One project for consumer durables and one for nondurables to be discussed.

TOTAL: 45 Hours

TEXT BOOKS:

1. Ralph S. Alexander, James S. Cross, Richard M. Hill, "Industrial Marketing", Homewood, 1967.
2. RajendraNargundkar, "Marketing Research", Tata McGraw Hill, 2008.

REFERENCE BOOKS:

1. Robert R. Reeder, Edward G. Brierty, Betty H. Reeder, "Industrial Marketing – Analysis, Planning and Control",Prentice Hall, 1991.
2. GhoshPK, "Industrial Marketing", Oxford University Press, India.
3. RamanujMajumdar, "Marketing Research-Text, Applications and Case Studies".
4. Donald R.Cooper, "Business research Methods", McGraw-Hill, 2005.

Weblinks:

- https: nptel.ac.in/courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Define industrial marketing, industrial demand and customer.	K3
CO2:	Explain the product pricing, price decision, discounts, purchase and leasing.	K3
CO3:	Explain the market research and it types, sources and collection of marketing data.	K4
CO4:	Describe in detail about the market research techniques	K5
CO5:	Describe the Setting up and Implementation of Marketing Research Project	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	PO 1	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
CO 1	1	1	2	2	2	-	-	-	-	-	-	-	1	1
CO 2	3	2	1	3	3	-	-	-	-	-	-	-	3	2
CO 3	2	2	1	3	1	-	-	-	-	-	-	-	2	2
CO 4	3	1	2	2	3	-	-	-	-	-	-	-	3	1
CO 5	1	2	1	3	2	-	-	-	-	-	-	-	1	2

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22OEAU10	DISASTER MANAGEMENT	L	T	P	Credits
		3	0	0	3

Course Objective:

➢ To ensure that students begin to understand the relationship between vulnerability, disaster, disaster prevention and risk reduction

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc - Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters, urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disaster: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

UNIT V DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation - Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

TOTAL: 45 Hours

TEXT BOOKS:

1. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
2. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012

REFERENCE BOOKS:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009

Weblinks:

- https://nptel.ac.in/courses
- https://swayam.gov.in

COURSE OUTCOMES:

CO1:	Differentiate the types of disasters, causes and their impact on environment and society	K3
CO2:	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	K3
CO3:	Explain Disaster damage assessment and management.	K4
CO4:	Describe Management Applications And Case Studies And Field Works	K5
CO5:	Explain Disaster Risk Management In India	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO →	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
CO 1	3	2	2	3	3	-	-	-	-	-	-	-	3	2
CO 2	2	1	1	2	2	-	-	-	-	-	-	-	2	1
CO 3	-	2	2	1	1	-	-	-	-	-	-	-	-	2
CO 4	2	1	1	2	2	-	-	-	-	-	-	-	3	1
CO 5	1	1	2	2	1	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22OEAU11	NEW PRODUCT DEVELOPMENT	L	T	P	Credits
		3	0	0	3

Course Objective:

> To understand to the basic concepts of engineering design and product development with focus on the front end processes

UNIT I INTRODUCTION   9

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research

UNIT II CUSTOMER NEEDS   9

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs- need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies

UNIT III CREATIVE THINKING   9

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition – functional representation –morphological methods-TRIZ- axiomatic design

UNIT IV DECISION MAKING AND PRODUCT ARCHITECTURE   9

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method- weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture –steps in developing product architecture

UNIT V DESIGN AND COST ANALYSIS   9

Industrial design – human factors design –cost friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing –methods of developing cost estimates – manufacturing cost –value analysis in costing

TOTAL: 45 Hours

TEXT BOOKS

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", Tata McGraw-Hill Education, 4th Edition, 2009
2. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, Indian Reprint 2015,

REFERENCE BOOKS:

1. Clive L Dym, Patrick Little, "Engineering Design, A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009,

2. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009

3. Yousef Haik, T M M Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010

Weblinks:

- https: nptel.ac.in/courses
- https: swayam.gov.in

COURSE OUTCOMES:

CO1:	Understand the need for developing new products	K3
CO2:	Attain the knowledge of creative thinking to develop new products	K3
CO3:	Familiar with decision making on new product development	K4
CO4:	Gain the knowledge on new product design and cost analysis	K5
CO5:	Familiar with the concept generation and selection tools	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

PO —	PO 1	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
CO1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO2	3	3	1	2	3	-	-	-	-	-	-	-	3	2
CO3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22HSPD01	PERSONALITY DEVELOPMENT I	L	T	P	Credits
		2	0	0	2

COURSE OBJECTIVES:

➢ To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders

UNIT I SOFT SKILLS I   6
Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality-Determinants of Personality–Features and Traits– Components of self-concept–Barriers–Self analysis

UNIT II SOFT SKILLS II   6
Importance of Soft Skills – First impression–Work Place requirements–Discipline Cleanliness Hygiene –general Appearance—Building Confidence—Concept of Thinking and Usage –Value of Time–Focus & Commitment.

UNIT III SOFT SKILLS IN ACTION   6
Grooming – Attire – Understanding others– Stability & Maturity Development – Strength s – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal settings

UNIT IV SELF AWARENESS AND SELF ESTEEM   6
Definitions – Components of Self-awareness – Developing Self-awareness – Self-esteem – meaning –Steps to improve self-esteem.

UNIT V SELF MOTIVATION   6
Motivation – Meaning –Techniques of self-motivation – Motivation & goal setting – Motivation and emotion – Motivation at work

TOTAL: 30 h

TEXT BOOKS:
1. Personality Development And Soft Skills Barun K Mitra, Oxford Publication
2. Seven habits of Highly Effective people – Stephen R. covey

REFERENCE BOOKS:
1. Emotion, motivation and Self-regulation – Nathan C. Hall, McGill University, Canada Thomas Goetz, University of Konstanz, Germany
   http://www.emeraldgrouppublishing.com.
2. Psychology of Self-esteem – Nathaniel Branden, Nash (1st edition), Jossey – Bass (32 nd anniversary edition)

Web links:
1. http://www.stevepavlina.com – Personal Development for Smart People
2. http://www.scotthyoung.com/blog – Get the most out of your life!
3. http://zenhabits.net/ – Smile, breathe and go slowly

4. http://www.craigharper.com.au – a tell-it-like-it-is Aussie Coach
5. http://www.personaldevelopment.ie – Dare to discover yourself
6. http://www.thechangeblog.com – a community blog on personal change
7. http://ripplerevolution.com/blog – work for positive change with Curt Rosengren
8. http://www.manifestyourpotential... – Find Your Gifts and Talents, Discover Your Dream Job, Career or Business
9. http://www.drphil.com/ – He tells it like it is to help you "Get Real"
10. http://www.oprah.com/ – Live Your Best Life

COURSE OUTCOMES:

CO1:	Discuss the features, dimensions and determinants of personality	K2
CO2:	Make a good first impression in professional and other situations	K3
CO3:	Demonstrate confidence, punctuality and commitment as an engineer	K3
CO4:	Set goals for development using SWOT analysis	K5
CO5:	Develop self-awareness and improve self esteem	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO2	3	3	1	2	3	-	-	-	-	-	-	-	3	3
CO3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exam	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	MCQ	Projects	Seminars	Demonstration/ Presentation	Open book test
			✓		✓

22HSPD02	PERSONALITY DEVELOPMENT II	L	T	P	Credits
		2	0	0	2

COURSE OBJECTIVES:

> ➤ To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders

UNIT I SOFT SKILLS   III   6
Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership - Team Management & Development

UNIT II QUANTITATIVE APTITUDE   I   6
Percentage – Profit Loss –Discount – Ratio Proportion – Time & Work – Time, Speed & Distance Problems relating to ages- Permutation & Combination–Probability

UNIT III QUANTITATIVE APTITUDE II   6
Mensuration – Clocks and Calendars – Boats – Simple Interest – Compound Interest – Fractions and Decimals – Square roots – Functions.

UNIT IV ANALYTICAL PROBLEMS   6
Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT V LOGICAL PROBLEMS   6
Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

                                                                                                        TOTAL: 30 h

TEXT BOOKS:
- T1 K. R. Dhanalakshmi and N S Raghunathan, Personality Enrichment, Margham Publications, 2012
- T2 R. S. Agarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publishers, 2017

REFERENCE BOOKS:
- R1 D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021
- R2 A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022

Web links:
1. http://www.stevepavlina.com/ – Personal Development for Smart People
2. http://www.scotthyoung.com/blog/ – Get the most out of your life!
3. http://zenhabits.net/ – Smile, breathe and go slowly
4. http://www.craigharper.com.au – a tell-it-like-it-is Aussie Coach
5. http://www.personaldevelopment.se/ – Dare to discover yourself

6. http://www.thechangeblog.com/ – a community blog on personal change
7. http://ripplerevolution.com/blog/ – work for positive change with Curt Rosengren
8. http://www.manifestyourpotential... – Find Your Gifts and Talents, Discover Your Dream Job, Career or Business
9. http://www.drphil.com – He tells it like it is to help you "Get Real"
10. http://www.oprah.com/ – Live Your Best Life

COURSE OUTCOMES:

CO1:	Discuss the basic, email, business, telephone and meeting etiquettes.	K2
CO2:	Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, speed and distance	K3
CO3:	Work with fractions, decimals and square roots.	K3
CO4:	Analyze the cause, effect and course of action in logical problems.	K4
CO5:	Solve problems on the letter and symbol series.	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO2	3	3	1	2	3	-	-	-	-	-	-	-	2	3
CO3	2	1	2	3	2	-	-	-	-	-	-	-	2	3
CO4	2	2	1	3	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓	✓	✓	✓	

		L	T	P	Credits
22HSPD03	PERSONALITY DEVELOPMENT III	2	0	0	2

COURSE OBJECTIVE:
> To enhance the communication, interpersonal group skills.

UNIT I VERBAL APPTITUDE I 6
Phonetics – Neutral Accent / Pronunciation – Speech Mechanism / Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II VERBAL APTITUDE II 6
Singular plural – present tense / past tense – genders Prepositions – conjunctions – Choice of words –simple sentences – compound sentences – summarizing phrases Synonyms – Antonyms – Analogies –Similar Words.

UNIT III SOFT SKILLS 6
Attitude – Meaning-Features of attitude – Formation – Personality Factors –Types of attitude – change in attitude – developing Positive attitude.

UNIT IV TIME MANAGEMENT 6
Definition – Meaning-Importance, Value of time as an important resource – comparison of Time and Money – Circle of influence and circle of control – Definition of URGENT and IMPORTANT – Time Wasters and how to reduce – Procrastination – meaning and impact – 4 Quadrants.

UNIT V TEAM BUILDING 6
Meaning – Aspects of team building – Process of team building – Types of Teams – Team Ethics and Understanding – Team trust and commitment.

TOTAL: 30 h

TEXT BOOKS:

T1 B N Ghosh, Managing Soft Skills and Personality, Mc graw Hill Publications
T2 Shejwalkar and Ghanekar,Principles and Practices of Management,Mc Graw Hill Latest
T3 Roberta Roesch,Time management for Busy people, Tata McGraw-Hill Edition

REFERENCE BOOKS:

R3 D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021
R4 Dr V M Selvaraj, Personality Development, Bhavani Publications

Web links:
1. http://www.steveparima.com/ – Personal Development for Smart People
2. http://www.scotthyoung.com/blog/ – Get the most out of your life!

3. http://zenhabits.net/ – Smile, breathe and go slowly
4. http://www.craigharper.com.au/ – a tell-it-like-it-is Aussie Coach
5. http://www.personaldevelopment.ie/ – Dare to discover yourself
6. http://www.thechangeblog.com/ – a community blog on personal change
7. http://ripplerevolution.com/blog – work for positive change with Curt Rosengren
8. http://www.manifestyourpotential... – Find Your Gifts and Talents, Discover Your Dream Job, Career or Business
9. http://www.drphil.com/ – He tells it like it is to help you "Get Real"
10. http://www.oprah.com – Live Your Best Life

COURSE OUTCOMES:

CO1:	Articulate by understanding the rate and flow of speech.	K3
CO2:	Choose words and phrases appropriately for any verbal communication	K3
CO3:	Develop a positive attitude in handling diverse situations	K4
CO4:	Prioritize important and urgent tasks using the four quadrants method	K4
CO5:	Practice team ethics and understanding when working with teams	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	1	-	-	-	-	-	-	-	2	2
CO2	3	3	1	2	2	-	-	-	-	-	-	-	2	2
CO3	2	1	2	3	2	-	-	-	-	-	-	-	2	1
CO4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓	✓	✓	✓	

22HSPD04	PERSONALITY DEVELOPMENT IV	L	T	P	Credits
		2	0	0	2

COURSE OBJECTIVES:

> To enhance the soft skills and prepare them towards the skills needed for their career.

UNIT I SOFT SKILLS
6

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication –Merits – forms of assertion – Causes of misunderstanding

UNIT II COMMUNICATION SKILLS
6

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III PRESENTATION SKILLS
6

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience –Types of presentations – How to make effective presentation.

UNIT IV PRESENTATION SKILLS II
6

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear.

UNIT V CHANGE MANAGEMENT
6

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leaders approach – Effective Change management.

TOTAL: 30 h

TEXT BOOKS:

T1 LeClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.

T2 Spencer Johnson, Who Moved My Cheese, Vermilion.First edition.

T3 Adair, John, Effective Communication, London: Pan Macmillan Ltd., 2003.

REFERENCE BOOKS:

R1 Bovee, Courtland L. John V. Thill & Barbara E. Schatzman, Business Communication Today, Tenth Edition, New Jersey: Prentice Hall, 2010.

Web links:

1. http://www.stevepavlina.com/ – Personal Development for Smart People
2. http://www.scotthyoung.com/blog/ – Get the most out of your life!
   11. http://zenhabits.net – Smile, breathe and go slowly
   12. http://www.craigharper.com.au – a tell-it-like-it-is Aussie Coach
   13. http://www.personaldevelopment.se/ – Dare to discover yourself
   14. http://www.thechangeblog.com/ – a community blog on personal change
   15. http://ripplerevolution.com/blog – work for positive change with Curt Rosengren
   16. http://www.manifestyourpotential – Find Your Gifts and Talents, Discover Your Dream Job, Career or Business
   17. http://www.drphil.com/ – He tells it like it is to help you "Get Real!"

18 http://www.oprah.com/ – Live Your Best Life

COURSE OUTCOMES:

CO1:	Be assertive in their communication	K3
CO2:	Differentiate the principles of formal and informal communication	K4
CO3:	Make an effective presentation by understanding the audience	K3
CO4:	Practice the rules of presentation using slides, PPT's and visuals	K3
CO5:	Discuss the principles of change management	K2

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	5	2	-	-	-	-	-	-	-	2	2
CO2	3	3	1	2	2	-	-	-	-	-	-	-	2	3
CO3	2	1	2	5	2	-	-	-	-	-	-	-	2	1
CO4	2	2	1	2	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	2	2	-	-	-	-	-	-	-	1	1

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	MCQ	Projects	Seminars	Demonstration Presentation	Open book test
✓	✓	✓	✓	✓	