

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Institution with UGC 12B Status
Marching Beyond 30 Years Successfully

B.Tech
Automation and Robotics Engineering

Curriculum and Syllabus
(Based on Choice Based Credit System)
Effective from the Academic year
2022-2023

Department of Mechanical Engineering
School of Engineering

DEPARTMENT OF AUTOMATION AND ROBOTICS ENGINEERING

Vision of the Department

The Department of Automation and Robotics Engineering envisages to be recognized as a role model in advanced fields of Automation and Robotics Engineering Education and Research and to cater the ever changing industrial demands and social needs.

Mission of the Department

M1: Educate, motivate and prepare the students to know the fundamental and technical skills in Automation and Robotics Engineering through effective teaching learning Methodologies.

M2: To imbibe professional and ethical standards in the minds of the young engineers by continuous learning and professional activities.

M3: To impart the employability skills to the students as industry ready by implant training and industrial visits.

M4: To create entrepreneurship skills by industrial collaborations and mentoring.

M5: To encourage students to undertake R&D activities for the societal needs with high ethical standards.

PROGRAMME OUTCOMES:

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 analyses

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 team work

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: Life-long learning

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

Programme Educational Objectives (PEO's)

The Graduates will be Automation and Robotics Engineering related technical and aptitude skills to offer best solution to industrial and societal problems.

PEO 1: To impart fundamentals of Engineering and Technology and applied Mathematics to transform the students as Mechanical Engineers.

PEO 2: To nurture design, analysis and implementation skills to innovate the process or system in Automation and Robotics Engineering with global context.

PEO 3: To imbibe Automation and Robotics Engineering related technical and aptitude skills to offer best solution to industrial and societal problems.

PEO 4: To initiate the entrepreneurial activities and leadership qualities of the students through the effective communication skills.

PEO 5: To develop the awareness among the students about the various social responsibilities related to Engineering ethics and human values with ecological.

Program Specific Outcomes (PSOs)

PSO 1	Graduate will be able to acquire core Automation and Robotics Engineering knowledge and able to solve industrial as well as societal problems with ethical and environmental consciousness.
PSO 2	Graduate will be able to build the nation, by imparting technological concepts and tools on emerging fields through the Managerial and entrepreneurs skills.

BOARD OF STUDIES

The details of the suggested Board of Studies (BOS) Members for the B.Tech. – Automation and Robotics / Mechanical Engineering are shown below.

S.No	Name of the Board Member	Designation	Institute / Industry
INTERNAL MEMBERS			
1	**Dr. M. Chandrasekaran**	Director, Mechanical Engineering	Vels Institute of Science, Technology & Advanced Studies (VISTAS)
2	**Dr. C. Dhanasekaran**	Engineering Coordinator & Head of the Department, Department of Mechanical Engineering	Vels Institute of Science, Technology & Advanced Studies (VISTAS)
3	**Dr. V. Muthuraman**	Professor, Department of Mechanical Engineering	Vels Institute of Science, Technology & Advanced Studies (VISTAS)
4	**Dr. R. Pugazhenthi**	Professor, Department of Mechanical Engineering	Vels Institute of Science, Technology & Advanced Studies (VISTAS)
5	**Dr. S. Sivaganesan**	Associate Professor, Department of Mechanical Engineering	Vels Institute of Science, Technology & Advanced Studies (VISTAS)
EXTERNAL EXPERT MEMBERS			
1	**Dr. V. Santhanam**	Professor, Department of Mechanical Engineering	RajalakshmiEngineering College, Chennai, Tamilnadu.
2	**Mr. S. Dwarakanathan**	Vice President (Retd.)	Brakes India Limited, Chennai, Tamilnadu.
3	**Mr. V. Venkatesh**	Unit Head	Suprajit Engineering Limited, Sriperumbadur, Chennai, Tamilnadu.

B.Tech. – Automation and Robotics Engineering

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.			
1.1	Demonstrate competence in mathematical modelling	1.1.1	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 Automation and Robotics 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 Automation and Robotics Engineering concepts to solve engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.			
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	2.1.1 Articulate problem statements and identify objectives
		2.1.2	2.1.2 Identify engineering systems, variables, and parameters to solve the problems
		2.1.3	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 model/s (mathematical or otherwise) of a system or process that is appropriate interms 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			
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 IEEE, ISO, ITU-R, ITU-T etc.
		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.			
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their 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.			
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools and 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	5.31	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.			
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	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

	regulations, legislation and standards		
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.			
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.			
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 Mechanical 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.			
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.
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			
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.			
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	11.2.1	Analyzeandselectthemostappropriateproposalbasedoneconomicandfinancial considerations.

	costs/benefits of alternate proposals for an engineering activity		
11.3	Demonstrate an ability to plan/manage an 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.			
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	Recognize 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	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.
PSO 1:Graduate will be able to acquire core Automation and Robotics Engineering knowledge and able to solve industrial as well as societal problems with ethical and environmental consciousness.			
13.1	Demonstrate and understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	13.1.1	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
		13.1.2	Identify risks/impacts in the life-cycle of an engineering product or activity
13.2	Demonstrate an ability to apply the Code of Ethics	13.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public
		13.2.1	Examine and apply moral & ethical principles to known case studies
PSO 2: Graduate will be able to build the nation, by imparting technological concepts and tools on emerging fields through the Managerial and entrepreneurs skills.			
14.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	14.1.1	Identify modern engineering tools and techniques and resources for engineering activities.
		14.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
14.2	Demonstrate an ability to form a team and define a role for each member	14.2.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		14.2.2	Implement the norms of practice (e.g., rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
14.3	Demonstrate an ability to identify changing trends in engineering knowledge and practice	14.3.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
		14.3.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.

B.Tech. – Automation and Robotics Engineering

CURRICULUM

TOTAL NUMBER OF CREDITS: 170

Category	Code No.	Course	Hours / Week			Credits	Maximum Marks		
			Lecture	**T**utorial	**P**ractical	**C**redits	CA	SEE	Total
SEMESTER I									
Humanities and Social Sciences	21HS101	English	2	0	0	2	40	60	100
Basic Science	21BS101	Physics (Introduction to Electromagnetic Theory)	3	1	0	3	40	60	100
Basic Science	21BS102	Mathematics – I (Calculus and Linear Algebra)	3	1	0	4	40	60	100
Engineering Course	21ES101	Basic Electrical Engineering	3	1	0	3	40	60	100
Engineering Course	21ES102	Engineering Graphics & Design	1	0	4	3	40	60	100
Basic Science Lab	21BL101	Physics Lab	0	0	4	1	40	60	100
Engineering Science Lab	21EL101	Electrical Engineering Lab	0	0	2	1	40	60	100
Humanities Lab	21HL101	English Lab	0	0	2	1	40	60	100
Mandatory Course		Student Induction Program	0	0	2	0	0	0	0
		Total	**14**	**1**	**10**	**18**			
SEMESTER II									
Basic Science	21BS201	Engineering Chemistry	3	1	0	3	40	60	100
Basic Science	21BS202	Mathematics – II	3	1	0	4	40	60	100
Engineering Course	21ES201	Programming for Problem Solving	3	0	0	3	40	60	100
Engineering Course		Engineering Mechanics	3	1	0	4	40	60	100
Basic Science Lab	21BL201	Chemistry Lab	0	0	4	1	40	60	100
Engineering Lab	21EL201	Programming for problem solving Lab	0	0	4	1	40	60	100
Engineering Course	21ES202	Workshop and Manufacturing Practices Lab	1	0	4	3	40	60	100
Mandatory Course	21MC201	Constitution of India	2	-	-	0	-	-	-
Mandatory Course		Universal Human Values - 2	0	0	2	0	0	0	0
		Total	**17**	**1**	**8**	**19**			

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Category	Code No.	Course	Hours / Week			Credits	Maximum Marks		
			Lecture	**T**utorial	**P**ractical	**C**redits	CA	SEE	Total
SEMESTER III									
Basic Science	21BS301	Mathematics III	3	0	0	4	40	60	100
Engineering Science	21PCME 301	Electrical Drives and Control	3	0	0	3	40	60	100
Professional Core	21ES301	Strength of Materials	3	0	0	3	40	60	100
Professional Core	21PCME 302	Digital Electronics	3	0	0	3	40	60	100
Professional Core	21PCME 303	Engineering Material Science and Testing	3	0	0	4	40	60	100
Professional Core	21PCME 304	Computer Aided Machine Design Laboratory	3	0	0	1	40	60	100
Professional Core	21PLME 301	Electronic Circuits and Digital Laboratory	0	0	3	1	40	60	100
Humanity science	21PLME 302	Personalty Development I (Effective Technical Communication)	0	0	3	2	40	60	100
Mandatory Courses	21HS301	Basic Life Skills	2	0	0	0	40	60	100
		Total	**19**	**1**	**6**	**21**			
SEMESTER IV									
Basic Science	21BSME 401	Mathematics IV	3	0	0	4	40	60	100
Professional Core	21ESME 401	Electrical Machines and Power systems	3	0	0	3	40	60	100
Professional Core	21PCME 401	Kinematics and Dynamics of Machines	3	0	0	3	40	60	100
Professional Core	21PCME 401	Sensors and Instrumentation	3	0	0	3	40	60	100
Professional Core	21PCME 402	Automatic Control Systems	3	1	0	4	40	60	100
Professional Core	21MCME401	Kinematics and Dynamics Laboratory	3	0	0	1	40	60	100
Professional Core	21HSME 401	Automatic Control Systems Laboratory	2	0	0	1	40	60	100
HSC	21PLME 401	Personality Development II	0	0	3	2	40	60	100
BSC	21PLME 402	Enviornmental Science and Engineering	0	0	3	3	40	60	100
Mandatory course		Industrial safety	0	0	2	0	40	60	100

Total	**22**	**0**	**6**	**24**	

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Category	Code No.	Course	Hours / Week			Credits	Maximum Marks		
			Lecture	**T**utorial	**P**ractical		CA	SEE	Total
SEMESTER V									
Professional Core	21PCME 501	Microcontrollers and PLC	3	1	0	4	40	60	100
Professional Core	21PCME 502	CNC Machine and Metrology	3	0	0	3	40	60	100
PEC	21PCME 503	Professional Elective Course -I	3	0	0	3	40	60	100
OEC	21PCME 504	Open Elective Course Technical -I	3	0	0	3	40	60	100
Professional Core	21OEME 501	Robot Design and Programming	3	0	0	3	40	60	100
Professional Core	21PEME 501	CNC and Metrology Laboratory	3	0	0	2	40	60	100
Professional Core	21HSME 501	Project – Design and Development	2	0	0	4	40	60	100
HSC	21PLME 501	Personality Development III	0	0	3	2	40	60	100
Professional Core	21PLME 502	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CoursEra/Mathworks) - Minimum 4 weeks	0	0	3	2	40	60	100
		Total	**17**	**0**	**10**	**26**			
SEMESTER VI									
Professional Core	21PCME 601	Fluid Power Automation	3	0	0	4	40	60	100
Professional Core	21PCME 602	Computer Integrated Manufacturing	3	0	0	3	40	60	100
Professional Elective courses	21PCME 603	Professional Elective courses II	3	0	0	3	40	60	100
Professional Elective courses	21PCME 603	Professional Elective courses III	3	0	0	4	40	60	100
Open Elective courses	21PEME 601	Open Elective Course Technical -II	3	0	0	3	40	60	100
Professional Core	21OEME 601	Automation System Design Laboratory	3	0	0	1	40	60	100
HSC	21HSME 601	Pesonality Development - IV	2	0	0	2	40	60	100
PCC	21PLME 601	Summer Internship (4 weeks)	0	0	3	2	40	60	100
		Total	**17**	**0**	**8**	**22**			

B.Tech. – Automation and Robotics

Category	Code No.	Course	Hours / Week			Credits	Maximum Marks		
			Lecture	**T**utorial	**P**ractical	**C**redits	CA	SEE	Total
SEMESTER VII									
Open Elective courses	21PEME701	Open Elective Course Technical -III	3	0	0	3	40	60	100
Open Elective courses	21PEME702	Open Elective Course Technical/ Management - IV	3	0	0	3	40	60	100
Professional Elective courses	21PEME703	Professional Elective courses IV	3	0	0	3	40	60	100
Professional Elective courses	21OEME701	Professional Elective Blended-V	3	0	0	4	40	60	100
PCC Blended	21PLME701	Field and Service Robots(Blended)	0	0	3	4	40	60	100
Project	21NSS701	Project Phase I	2	0	0	6	40	60	100
		Total	**15**	**0**	**11**	**23**			
SEMESTER VIII									
Professional Elective courses	21PEME801	Professional Elective courses VI	3	0	0	3	40	60	100
Open Elective courses	21OEME801	Open Elective Course Technical -V	3	0	0	3	40	60	100
Open Elective courses	21OEME802	Open Elective Course Technical/ Management - VI	3	0	0	3	40	60	100
Project	21PRME801	Project Phase II	0	0	16	8	40	60	100
		Total	**9**	**0**	**18**	**17**			

CURRICULUM

LIST OF PROFESSIONAL ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	**T**utorial	**P**ractical	**C**redits
21PBME51	VLSI Design	3	0	0	3
21PME52	Virtual Instrumentation	3	0	0	3
21PBME53	Industrial Design and Applied Ergonomics	3	0	0	3
21PBME61	Artificial Intelligence for Robotics	3	0	0	3
21PBME62	Special Machines and Controllers	3	0	0	3
21GBME63	Advanced Control Systems	3	0	0	3
21PBME71	Fundamentals of Nanoscience	3	0	0	3
21PBME72	Industrial Robotics and Material Handling Systems	3	0	0	3
21PBME73	Embedded System Design	3	0	0	3
21PBME74	Wireless Sensors Networks for Robotics	3	0	0	3
21PBME81	Micro Electro Mechanical Systems	3	0	0	3
21PBME82	Digital Signal Processors and its Applications	3	0	0	3
21PBME83	Internet Tools and Java Programming	3	0	0	3
21PBME51	Computer Integrated Manufacturing Systems	3	0	0	3
21PBME52	Additive Manufacturing	3	0	0	3
21PBME53	Finite Element Methods	3	0	0	3
21PBME61	Machine Vision Systems	3	0	0	3
21PBME62	System Software	3	0	0	3
21PBME63	Field and Service Robotics	3	0	0	3
21PBME71	Maintenance and Safety Engineering	3	0	0	3
21PBME72	Neural Networks and Fuzzy Systems	3	0	0	3
21PBME73	Micro Manufacturing	3	0	0	3
21PBME74	Non Destructive Testing and Evaluation	3	0	0	3

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CURRICULUM

LIST OF OPEN ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	**T**utorial	**P**ractical	**C**redits
21GBME51	Principles of Management	3	0	0	3
21GBME52	Operations Research	3	0	0	3
21GBME53	Human Rights	3	0	0	3
21GBME61	Professional Ethics in Engineering	3	0	0	3
21GBME62	Quality Control and Reliability Engineering	3	0	0	3
21GBME63	Value Analysis and Value Engineering	3	0	0	3
21GBME71	Total Quality Management	3	0	0	3
21GBME72	Production Planning and Control	3	0	0	3
21GBME73	Energy Audit and Energy Conservation Methods	3	0	0	3
21GBME74	Quality Control and Reliability Engineering	3	0	0	3
21GBME81	Process Planning and Cost Estimation	3	0	0	3
21GBME82	Supply Chain Management	3	0	0	3
21GBME83	Industrial Marketing and Market Research	3	0	0	3
21GBME84	Intellectual Property Rights	3	0	0	3
21GBME85	Disaster Management	3	0	0	3
21GBME86	Engineering Economics	3	0	0	3
21GBME87	Entrepreneurship Development	3	0	0	3

LIST OF HUMANITIES AND SOCIAL SCIENCES ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	**T**utorial	**P**ractical	**C**redits
21HS101	English	2	0	0	2
21HL101	English Lab	0	0	2	1
21MC201	Constitution of India	-	-	-	0
21NSS255	NSS	2	0	0	2
21MCME401	Environmental Science and Engineering	3	0	0	3
21MCME402	Yoga	0	0	2	1

B.Tech. – Automation and Robotics Engineering

CURRICULUM

LIST OF BASIC SCIENCE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
21BS101	Physics (Introduction to Electromagnetic Theory)	3	1	0	4
21BS102	Mathematics – I (Calculus and Linear Algebra)	3	1	0	4
21BL101	Physics Lab	0	0	4	2
21BS201	Chemistry	3	1	0	4
21BS202	Mathematics – II	3	1	0	4
21BL201	Chemistry Lab	0	0	4	2
21BS302	Mathematics III	3	0	0	3
21BS402	Mathematics IV	3	0	0	3

LIST OF ENGINEERING COURSE

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
21ESME101	Basic Electrical Engineering	3	1	0	4
21ESME102	Engineering Graphics & Design	1	0	4	3
21ELME101	Electrical Engineering Lab	0	0	2	1
21ESME201	Programming for Problem Solving	3	0	0	3
21ELME201	Programming for problem solving Lab	0	0	4	2
21ESME202	Manufacturing Practices Lab	1	0	4	3
21ESME301	Electrical Drives and Control	3	0	0	3
21ESME401	Strength of Materials	3	0	0	3

LIST OF EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
21SUPD31	Personality Development I	2	0	0	2
21SUPD41	Personality Development II	2	0	0	2
21SUPD51	Personality Development III	2	0	0	2
21SUPD61	Personality Development IV	2	0	0	2
21ECME301	Industrial Safety	2	0	0	2
21ECME501	Industrial Visit	0	0	0	0
21ECME601	Internship	0	0	2	1
21PRME701	Project Phase I	0	0	10	5
21PRME801	Project Phase II	0	0	16	8

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project
CA	Continuous Assessment
SEE	Semester End Examination

B.Tech. – Automation and Robotics Engineering
SUMMARY OF CURRICULUM COMPONENTS

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences Courses	3	-	2	2	2	2	-	-	11	6.47
2	Basic Science Courses	8	8	4	7	-	-	-	-	27	15.88
3	Engineering Courses	7	11	3	-	-	-	-	-	21	12.35
4	Professional Elective Courses	-	-	-	-	3	7	11	3	24	14.11
5	Open Elective Courses	-	-	-	-	3	3	6	6	18	10.58
6	Professional Core Courses	-	-	12	15	18	10	-	-	55	32.35
7	Project	-	-	-	-	-	-	6	8	14	8.23
8	Mandatory Courses	-	-	-	-	-	-	-	-	0	0
	Total	18	19	21	24	26	22	23	17	170	100

SEMESTER I

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

Reference Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007

(iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Weblinks:

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

Course Outcome

CO1:	Improve the language proficiency of a technical under-graduate in English with emphasis on Learn, Speak, Read and Write skills.	**K2**
CO2:	Develop listening skills for academic and professional purposes	**K3**
CO3:	Acquire the ability to speak effectively in English in real life situations	**K3**
CO4:	Provide learning environment to practice listening, speaking, reading and writing skills.	**K3**
CO5:	Variety of self-instructional modes of language learning and develop learner autonomy.	**K4**

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
Average		1	2	2	2	1.75	2.5	1.75	2.5	2.5	2.5	2.5	-	2

Assessment Methods:

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

	Mathematics-I (Calculus and Linear Algebra)	3L:1T:0P	4 credits

Course Objectives

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

Unit-I: Calculus **(12 hours)**

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 **(12hours)**

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

Unit-III: Sequence and series **(12hours)**

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 **(12 hours)**

Introduction to Matrices- Rank of matrix- Linear systems 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 **(12 hours)**

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:

1. G.B.Thomas and R.L.Finney, Calculus and Analytic geometry, 9th Edition,Pearson,Reprint, 2002.
2. Ramana B.V., Higher Engineering Mathematics,Tata McGraw Hill New Delhi, 11,Reprint,2010
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference books:

1. P. Sivaramakrishna Das and C. Vijayakumari, Mathematics-I, First Edition, Pearson India Education services Pvt. Ltd.
2. Erwinkreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley&Sons, 2006.
3. VeerarajanT.,Engineering Mathematics for firstyear,TataMcGraw-Hill,NewDelhi,2008.
4. D.Poole, LinearAlgebra: A ModernIntroduction,2nd Edition, Brooks/Cole,2005.
5. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.

Course Outcome

CO1:	Apply the concept of differential calculus and to evaluate the curvature, radius of curvature and envelope	**K3**
CO2:	Understand the concept of limits, continuity and to evaluate derivatives	**K2**
CO3:	Analyze the convergence of the series using root test, D'Alembert's test, Leibnitz'stest	**K3**
CO4:	Determine the rank of a matrix, linear system of Equation and Eigen values and Eigenvectors	**K3**

CO5:	Evaluate the linear independence and dependence of vectors, linear transformations and inner product space.	**K4**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

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

	Electromagnetism (For B.E Mechanical Engineering)	L	T	P	Credits
		3	0	0	3

Course Objectives

- To learn the basics of electrostatics in vacuum, liner dielectric medium, magnetostatics 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 equatorial 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.

CO2: Utilize the various types of polarization mechanisms in dielectrics.

CO3: Identify the applications of dielectric materials.

CO4: Select the types of magnetic materials and their applications.

CO5: Analyze the theoretical aspects of Domain theory of ferromagnetism.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO 2**	**PO3**	**P O4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1	1	1	0	1	0	0	0	0	0	1	1
CO2	1	1	1	1	1	0	1	0	0	0	0	0	0	1
CO3	1	1	1	2	1	0	1	0	0	0	0	0	3	2
CO4	2	1	1	2	1	0	1	0	0	0	0	0	3	2
CO5	2	1	1	1	1	0	1	0	0	0	0	0	0	1
Average	**1.6**	**1**	**1**	**1.4**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1.4**	**1.4**

ASSESSMENT METHODS:

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

	BASIC ELECTRICAL ENGINEERING	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.

UNIT III 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.

UNIT IV 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:

R1: 3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.

R2: 4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

R3: 5. 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 converter 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	2	1	1	1	1	1	-	-	1	-	1	3	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	3	-
CO3	1	1	1	1	1	3	3	2	-	1	1	1	-	-
CO4	1	-	1	1	1	3	1	1	-	1	1	1	-	1
CO5	2	1	1	1	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**
√	√			√	√

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

COURSE OBJECTIVE:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I INTRODUCTION TO ENGINEERING DRAWING AND PLANE CURVES 12

Curves used in engineering practices: 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. Scales – Plain, Diagonal and Vernier Scales.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes - Auxiliary Planes.

UNIT III PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method - Auxiliary Views.

UNIT IV 12

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section - Auxiliary Views. Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V 12

Free hand sketching: Representation of Three-Dimensional objects – 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:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46 th Edition, (2003).
2. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).

REFERENCES

1. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
2. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
3. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
4. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
5. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

Course Outcome

CO1:	Understand the theory of projection able to know and understand the conventions and the methods of engineering drawing	**K2**
CO2:	Improve their visualization skills so that they can apply these skills in projections of surfaces	**K3**
CO3:	Improve their visualization skills so that they can apply these skills in projections of solids	**K3**
CO4:	Impart and inculcate a proper understanding of the theory of projection. Improve the visualization skills	**K3**

CO5:	Understand the various concepts like dimensioning, conventioning and standards related to working drawings in order to become professionally efficient. Impart the knowledge for understanding and drawing of simple residential/office buildings	**K4**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

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

	ENGINEERING PRACTICAL - ENGLISH	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 HOURS**

1. Introduction to English sounds
2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarizing
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 Outcome

CO1:	Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.	**K5**
CO2:	Use appropriate pronunciation and rhythm of spoken language in oral communication	**K4**
CO3:	Draft and interpret the written communication in officialcontexts 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.	**K4**
CO5:	Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions , negotiation and conversations.	**K2**

Mapping of Program outcomes with course outcomes

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
		K3	K4	K5	K5	K3, K4, K5	K5	K3	K5	K6	K6	K6	K6	K4, K6	K3, K4
CO1	**K5**	2	1	-	-	2	-	2	-	-	-	-	-	-	2
CO2	**K4**	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO3	**K5**	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO4	**K4**	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO5	**K2**	3	2	1	1	3	1	3	3	-	-	-	-	-	3

Assessment Methods:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observations**
Record	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**

	ENGINEERING PRACTICAL - PHYSICS	L	T	P	Credits
		0	0	2	1

Course Objectives

- To enable the student to explore the field of Properties of Matter and Optics.
- 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:

1. C. C. Ouseph, U. J. Rao, V. Vjiayendran, Practical Physics,1st Edition, 2015.
2. 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:	Measure the wavelength and particle size of semiconductor diode laser.	**K5**
CO2:	Analyze the wavelength of spectral lines using spectrometer	**K4**
CO3:	Estimate the band gap energy of given semiconductor material.	**K5**
CO4:	Determine the compressibility of the liquid using ultrasonic interferometer.	**K4**
CO5:	Measure the Young's modulus of the given solid materials.	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO 2	PO3	P O4	PO5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	1	1	3	2	1	1	-	-	-	-	-	3	3
CO2	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO3	-	1	1	3	2	1	1	-	-	-	-	-	1	1
CO4	-	1	1	3	-	-	-	-	-	-	-	-	1	-
CO5	-	1	1	3	1	1	1	-	-	-	-	-	1	-

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**

	Basic Electrical and Electronics Engineering Laboratory	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 calculation 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.

TOTAL: 30 hours

COURSE OUTCOMES

CO1:	Understand the basic safety precautions and learn to make use of measuring instruments	**K2**
CO2:	Analyse 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	PO10	PO11	PO12	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	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**

	CONSTITUTION OF INDIA	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 hours

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 hours

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 hours

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE 6 hours

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 hours

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 hours

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.

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**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	3	-	1	-	-	-	2	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**

SEMESTER II

	Engineering Chemistry	L	T	P	Credits
		3	0	0	3

Course Objectives

- To learn about the molecular orbitals, ionic interactions and periodic properties.
- Rationalise periodic properties such as ionization potential, electronegativity, 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 and potential energy surfaces **9 hours**

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic andmolecular 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 IISpectroscopic techniques and applications **9 hours**

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 hours**

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 hours**

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 hours**

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

CO1:	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	**K2**
CO2:	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	**K3**
CO3:	Analyze bulk properties and processes using thermodynamic considerations.	**K4**
CO4:	Classify the properties and reactivity of different types of elements based on the periodic table.	**K3**
CO5:	Apply the basic terms involved in an Organic reactions and synthesis of a drug molecule.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	**P O2**	**PO 3**	**P O4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
CO1	1	1	1	1	1	-	1	-	1	1	-	1	1	-
CO2	2	1	1	1	1	-	-	-	1	-	-	-	-	-
CO3	2	1	1	1	-	-	-	-	-	1	-	-	-	-
CO4	1	1	1	1	-	-	-	-	-	-	-	-	-	1
CO5	2	1	-	1	-	-	1	-	-	-	-	-	-	1
Average	1.6	1	0.8	1	0.4	-	0.4	-	0.4	0.4	-	0.2	0.2	0.67

ASSESSMENT METHODS:

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

PC 04	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE :(Skill development)

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.,
- 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 force – 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 Couple – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scala 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, triangl from integration – T section, I section, Angle section, Hollow section by using standard formula – second and produc 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 – Principa moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment o 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.

CO5: 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.

Mapping of Program out comes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	3	2	1	1	2	2	-	-	-	-	-	3	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

	Electromagnetism (For B.E Mechanical Engineering)	L	T	P	Credits
		3	0	0	3

Course Objectives

- To learn the basics of electrostatics in vacuum, liner dielectric medium, magnetostatics in a liner magnetic medium.
- To apply these fundamental principles to electromagnetic waves.

UNIT I Electrostatics in vacuum

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 equatorial 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.

CO2: Utilize the various types of polarization mechanisms in dielectrics.

CO3: Identify the applications of dielectric materials.

CO4: Select the types of magnetic materials and their applications.

CO5: Analyze the theoretical aspects of Domain theory of ferromagnetism.

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO 2**	**PO3**	**P O4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1	1	1	1	0	1	0	0	0	0	0	1	1
CO2	1	1	1	1	1	0	1	0	0	0	0	0	0	1
CO3	1	1	1	2	1	0	1	0	0	0	0	0	3	2
CO4	2	1	1	2	1	0	1	0	0	0	0	0	3	2
CO5	2	1	1	1	1	0	1	0	0	0	0	0	0	1
Average	**1.6**	**1**	**1**	**1.4**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1.4**	**1.4**

ASSESSMENT METHODS:

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

	Mathematics-II (Probability and Statistics)	3L:1T:0P	4 credits

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

UNIT I: Basic Probability: (12 hours)
Introduction to Probability-Conditional probability – Baye's Theorem- Random Variables-Discrete random variables-Continuous Random Variables –Probability mass function-Probability density function.

UNIT II: Standard Distributions: (12 hours)
Introduction to theoretical distribution-Discrete Distributions- Binomial, Poisson, Geometric Distributions-Continuous Distribution-Uniform, Normal, Exponential and Gamma distribution-Properties.

UNIT III: Correlation and Regression Analysis: (12 hours)
Correlation: Types of Correlation-Methods of studying correlation- Scatter diagram method, Karl Pearson's Coefficient of correlation, Spearman's Rank Correlation Coefficient. Regression: Regression Lines and Regression equations - simple problems

UNIT IV: Basic Statistics: (12 hours)
Introduction-Measures of Central tendency: Mean, Median and Mode- Measure of Dispersion- Range, Mean deviation- Standard Deviation and coefficient of variation

UNIT V: Sampling : (12 hours)
Introduction to small sample – t-test-Single mean, difference of means, and Paired t-test- F-test- Chi- square test for goodness of fit and independence of attributes.

Total Hours: 60

Text Books

1. N.P. Bali and Manish Goyal, A text book of engineering mathematics, laxmi publications, reprint, 2014 (Ninth Edition)
2. S.P.Gupta, Statistical Methods. Sultan Chand & Sons, New Delhi
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 3rd Edition, 2001.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Reference Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

Course Outcome

CO1:	Apply the fundamental concepts of probability.	**K3**
CO2:	Understand of standard distributions which can describe real life phenomenon.	**K2**
CO3:	Understand and critically discuss the issues surrounding of correlation and Regression	**K3**
CO4:	Evaluate the underlying assumptions of analysis tools of measures of central tendency and dispersion	**K4**
CO5:	Analyze the uses and limitations of Testing of hypothesis used in engineering	**K4**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

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

	PROGRAMMING FOR PROBLEM SOLVING	3	0	0	3

Course Objectives

- To understand the basic concepts of programming – Flow chart, Pseudocode.
- 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 hours

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 hours

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 hours

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 hours

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 hours

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: YashavantKanetkar, “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:	Determine a pictorial representation with a stepwise procedure for solving complex problems	**K2**
CO2:	Develop a high level programming code using c languages.	**K3**
CO3:	Evaluate the various functional operations for solving problem.	**K4**

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.	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	1	1	-	-	-	-	-	-	2	3	-
CO2	3	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	2	3	1	2	-	-	-	-	-	-	2	3	2
CO5	3	2	3	2	2	-	-	-	-	-	-	2	3	3

ASSESSMENT METHODS:

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

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

GROUP A – MECHANICAL AND CIVIL ENGINEERING PRACTICES

COURSE OBJECTIVE:

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study Arc welding drawings for making common weld joints as per the given dimensions.
- To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

MECHANICAL ENGINEERING PRACTICE

1. Welding

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

2. Basic Machining

To make Simple Turning and Taper turning in the lathe.

3. Fitting Work

To make square, hexagonal, V joint in bench fitting as per the given dimensions and Tolerances.

4. Sheet Metal Work

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

CIVIL ENGINEERING PRACTICE

1. Buildings

a. Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

2. Plumbing Works

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

TOTAL: 60 Hours

Course Outcome

CO1:	Understand the various type of workshop machines and practices in manufacturing	**K2**
CO2:	Develop operating skills in different workshop machines	**K3**
CO3:	Develop simple objects and illustrations based on the dimensions	**K3**
CO4:	Measure the parameters and features of the workshop and manufacturing machines	**K5**
CO5:	Demonstrate the complete functioning and process of the workshop machines	**K2**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

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

	ENGINEERING CHEMISTRY PRACTICALS	L	T	P	Credits
		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.

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 Books

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-law/v/experimental-determination-of-rate-laws
2. https://www.youtube.com/watch?v=qdmKGskCyh8
3. https://www.youtube.com/watch?v=7_6_dKlo67k

COURSE OUTCOMES

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.	**K4**
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 Program outcomes with course outcomes

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

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**

	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	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 hours

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

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation
Record	**MCQ**	**Projects**	**Viva**	**Demonstration / Presentation**

	UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY	2 0 0 0

COURSE OBJECTIVES:

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

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

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 hours

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 hours

Understanding harmony in the Family- the basic unit of human interaction, Understanding values in a 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 (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!.

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

Understanding the harmony in 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 Implications of the above Holistic Understanding of Harmony on ProfessionalEthics 6 hours

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 identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for the 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.

Text Books:

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

References:

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 toGrowth – Club of Rome's report, Universe Books.

COURSE OUTCOMES

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	**K2**
CO2:	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.	**K3**
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	**K2**
CO4:	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	**K3**
CO5:	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	**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	3	1	-	3	2	-
CO2	-	-	-	-	-	3	2	2	3	1	-	3	2	-
CO3	-	-	-	-	-	3	3	2	3	1	-	3	2	-
CO4	-	-	-	-	-	3	2	2	3	1	-	3	2	-
CO5	-	-	-	-	-	3	3	3	3	**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**

SEMESTER III

PC 15	MATHEMATICS-III	L	T	P	C
		0	0	3	4

Course Objective:

- Using appropriate numerical methods determine approximate solutions to ordinary differential equations.
- Analyze the errors obtained in the numerical solution of problems.

UNIT I Solution of Equations **12**

Solution of algebraic and transcendental equations – Newton Raphson method –Regulafalsi Method – Solution of linear system of equations- Gauss elimination method – Gauss-Jordon method–Gauss Seidel Method–Gauss Jacobi Method–Matrix Inversion by Gauss Jordon method.

UNIT II Interpolation and Approximation **12**

Interpolationwithunequalintervals-Lagrange'sinterpolation–InverseLagrange'sinterpolation–Newton'sdivided difference interpolation– Interpolation with equal intervals– Newton's forward and backward difference formulae

UNIT III Numerical Differentiation and Integration **12**

Numerical Differentiation: Approximation of derivatives using interpolation polynomials-Numerical integration: Trapezoidal–Simpson's 1/3 and 3/8 rule – Romberg's method – Double integral of Trapezoidal – Simpson's Rule

UNIT IV Initial Value Problems for Ordinary Differential Equations **12**

Single step methods: Taylor series method – Euler's method–Modified Euler's method– Second order Runge –Kutta method and Fourth order Runge–Kutta method for solving first order equations

UNIT V Boundary Value Problems in Ordinary and Partial Differential Equations **12**

Finite difference methods for solving two-point linear boundary value problems– Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain

TotalHours: 60

TEXTBOOKS:

1. Grewal,B.S.andGrewal,J.S.,"NumericalmethodsinEngineeringandScience",9thEdition,Khanna Publishers,New Delhi, 2012.
2. Gerald,C.F.andWheatley,P.O.,"AppliedNumericalAnalysis",6thEdition,PearsonEducation,Asia,New Delhi, 2006.
3. SivaramakrishnaDas.PandVijayakumari.C,NumericalAnalysis,2014,PearsonEducationLimited inSouthAsia.

REFERENCEBOOKS:

1. Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers",Tata McGraw-Hill, NewDelhi,5thEdition, 2007.
2. SankaraRaoK,"NumericalMethodsforScientistsandEngineers",PrenticeHallofIndia,NewDelhi, 3rdEdition,2007.

CourseOutcome

CO1:	Applynumericalmethodstoobtainapproximatesolutionstomathematicalproblems.	**K3**
CO2:	Understandnumericalmethodsforvariousmathematicalinterpolationproblems.	**K2**
CO3:	Evaluatedifferentiationandintegrationsolutionsusingnumericalmethods.	**K3**
CO4:	UnderstandtheinitialvalueproblemforOrdinarydifferentialEquations.	**K4**
CO5:	Understand the boundary value problem for Ordinary differential equations and Partial	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	**CAT2**	**ModelExam**	**SemesterExams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

PC 03 ELECTRICAL DRIVES AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVE: (Employability)

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives.

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 - DOI –starter and auto transformers 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

COURSE OUTCOMES:

After successful completion of the Electrical Drives and Control course, the student will be able to

CO1:	Identify the need and choice of various electrical drives and their controls.
CO2:	Designing the circuit with the Microprocessors.
CO3:	Understand the DC motor by Single phase converters.
CO4:	Discuss the four quadrant operation of DC drives.
CO5:	Explain the control of induction motor; through station voltage.

TEXT BOOKS:

1. N.K De and P.K Sen ‘Electric Drives’ Prentice Hall of India Private Ltd, 2002.
2. VedamSubramaniam ‘Electric Drives’ Tata McGraw Hill, New Delhi, 2007.
3. V.K Mehta and Rohit Mehta ‘Principle of Electrical Engineering’, S Chand & Company, 2008.

REFERENCE BOOKS:

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.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	2	1	-	-	1	-	-	-	-	-	-	-	2	1
CO2	-	1	2	-	2	2	-	-	3	-	-	3	1	3
CO3	2	1	-	-	1	-	-	-	-	-	-	-	1	1
CO4	-	1	2	-	2	2	-	-	3	-	-	3	1	1
CO5	1	2	3	-	3	3	-	-	2	-	-	2	1	1

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentaon**

PC 10	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE : (Employability)

- To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS - LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III TORSION 9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads.

UNIT IV BEAM DEFLECTION 9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method –Columns and its types – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Strength of Materials course, the student will be able to

- **CO1:** Analyze the rigid bodies and deformable solids response when subjected to different stresses and measure the strain and the relationship of stress and strain.
- **CO2:** Analyze the different types of beam response when subjected to different types of loads, shear stresses and evaluation of shear force and bending moment diagram.
- **CO3:** Analyze the different types of shaft and spring response when subjected to torsion forces axially and design of helical coil spring, analysis of deflection and stresses.
- **CO4:** Evaluation of beam deflection and slope using different mathematical methods and column subjected to different end conditions.
- **CO5:** Analyses of stresses in two dimensions of thin cylindrical and spherical shells and solve stresses at a point and inclined planes.

TEXT BOOKS:

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.
2. Beer F. P. and Johnston R, "Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.

REFERENCE BOOKS:

1. Nash W.A, “Theory and problems in Strength of Materials”, Schaum Outline Series, McGraw-Hill Book Co, New York, 1995
2. Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co, New Delhi, 1981
3. Ryder G.H, “Strength of Materials”, Macmillan India Ltd., Third Edition, 2002
4. Ray Hulse, Keith Sherwin & Jack Cain, “Solid Mechanics”, Palgrave ANE Books, 2004.
5. Singh D.K “Mechanics of Solids” Pearson Education 2002.
6. Timoshenko S.P, “Elements of Strength of Materials”, Tata McGraw-Hill, New Delhi 1997.

CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	3	2	2	2	2	-	-	-	-	-	1	2	2
CO2	2	3	2	2	2	2	-	-	-	-	-	1	2	2
CO3	1	2	2	2	2	2	-	-	-	-	-	2	3	2
CO4	1	2	2	2	2	2	-	-	-	-	-	2	2	3
CO5	2	3	2	2	2	2	-	-	-	-	-	1	2	2

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presenta on**

PC 10	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE : (Employability)

- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices

UNIT I LOGIC GATES, BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES 9

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, Minimum of Boolean Expressions, Minterm, Maxterm, Sum Of Products (SOP) & Product Of Sums (POS) forms, Canonical forms, Karnaugh maps, Quin McCluskey method of minimization

UNIT II COMBINATIONAL LOGIC DESIGN 9

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Adder, Parallel Subtractor, Look Ahead Carry Generator, BCD Adder, Code Converters, Magnitude Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.

UNIT III SEQUENTIAL LOGIC DESIGN 9

Flip Flop design: S-R, JK, D and T Flip Flop, Realization of Flip flops, Counters: Modulo N Counter, UP/DOWN Counter, Ripple Counter, Ring Counter, Shift registers- SISO, SIPO, PIPO, PISO and Universal Shift Register, Algorithmic State Machines Charts, Cycles, Races, Hazards.

UNIT IV MEMORIES, PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES 9

Memories: ROM, PROM, EPROM, EEPROM, RAM, Static RAM cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM CELL. Programmable logic devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA). Logic Families: TTL, ECL, CMOS

UNIT V VHDL CONCEPTS IN DIGITAL DESIGN 9

Design entry: Different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, VHDL constructs and codes for combinational and sequential circuits.

COURSE OUTCOMES:

After successful completion of the Strength of Materials course, the student will be able to

CO1: Examine the laws of Boolean algebra and Simplify minterms and maxterms using K map and tabulation methods.

CO2: Analyze combinational logic circuits like adders, subtractors, multiplexers and Demultiplexers

CO3: Distinguish the operations of SR,JK,T and D flip-flops

CO4: Criticize the different types of memories and their designs.

CO5: Compile VHDL codes to design combinational and sequential circuits.

TEXT BOOKS

T1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.

T2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
T3. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
T4. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006.

REFERENCE BOOKS

R1. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2ndedition, 2006.
R2. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989.
R3. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2ndedition2012.
R4. Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

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	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO3	1	3	3	2	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	1	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	1	2	2	2
	2	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**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**
✓	✓				✓

Course Code	ENGINEERING MATERIAL SCIENCE AND TESTING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVE

- Develop the knowledge on the structure, properties, Heat treatment, testing of various materials.
- Understands the applications of Engineering metals and non-metallic materials. Identify and select suitable materials for various engineering applications.

UNIT I ALLOYS AND PHASE DIAGRAMS 8

Constitution of alloys – Solid solutions, substitution 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.

Examination of crystal structure by using Metallography / Materialography Machines-To study the Carbon composition of given Ferrous material.

UNIT II HEAT TREATMENT 10

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.

Experiments on Muffle Furnace for various Heat treatment processes.-Determination of Hardenability of a given specimen-Determination of Coating Thickness of a hardened surface of specimen Tempering-Improvement Mechanical properties Comparison Unhardened specimen, Quenched Specimen and Quenched and tempered specimen.

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. Microscopic Examination of Hardened samples and Hardened and tempered samples by using Metallurgical Microscopes Analysis of alloy composition of a given specimen using Metal Tester/Alloy Analyzer Effect of hardening- Improvement in hardness and impact resistance of steels.

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 Al2O3, SiC, Si3N4, PSZ and SIALON –Composites-Classifications- Metal Matrix and FRP - Applications of Composites. Estimate the composition of the given specimen using Polymer/Ceramic Tester Experiments on Polariscope Strain Viewer.

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 lzod and charpy, fatigue and creep failure mechanisms. Surface Testing-SEM,AFM,EDS,XRD and Residual stress Tension test on a mild steel rod-Double shear test on Mild steel and Aluminium rodsTorsion test on mild steel rod-Impact test on metal specimen-Hardness test on metals - Brinnell and Rockwell Hardness Number-Deflection test on beams-Compression test on helical springs-Strain Measurement using Rosette strain gauge-Fracture Image analyserAFM/XRD/ SEM/TEM

TOTAL: 45 Hours

TEXT BOOKS:

1. Avner,, S.H., “Introduction to Physical Metallurgy”, McGraw Hill Book Company,1994.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition 2007.

REFERENCE BOOKS:

1. Raghavan. V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 1999.

2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint 2002.
3. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006.
4. U.C. Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012

Web Links:

1. **https://www.digimat.in/nptel/courses/video/113107078/L01.html**
2. https://www.digimat.in/nptel/courses/video/113102080/L43.html

COURSE OUTCOMES

CO1:	Understanding constitutions of alloys phase diagram, Iron-Iron carbon diagram and steel classification	**K2**
CO2:	Analyze isothermal transformation, continuous cooling diagrams and different heat treatmen processes.	**K4**
CO3:	Clarify the effects of alloying elements on ferrous and non-ferrous metals.	**K4**
CO4:	Explain the properties and applications of non-metallic materials.	**K5**
CO5:	Explain the testing of mechanical properties.	**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	-	2	-	-	-	-	-	3	1
CO2	2	1	-	-	1	-	2	-	-	-	-	-	3	2
CO3	2	3	2	2	3	2	2	-	-	-	-	1	2	1
CO4	-	1	2	2	2	2	-	-	-	-	-	3	3	2
CO5	2	1	-	-	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**

	COMPUTER AIDED MACHINE DESIGN LABORATORY	L	T	P	C

Course Objectives
To develop skill to use software to create 2D and 3D models.

UNIT I INTRODUCTION **12 hours**

Introduction to machine components and interpret drawings of machine component so as to prepare assembly drawing either manually and using standard CAD packages.

UNIT II DRAWING STANDARDS **12 hours**

Code of practice for engineering drawing, BIS specifications-conventional representation of details- Welding symbols, riveted joints, keys, Fasteners. Reference to hand book for the selection of standard components like-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges

UNIT III 2-D DRAWINGS **12 hours**

Limits, Fits- Tolerancing of Individual Dimensions-Specification of Fits -Manual preparation of production drawings and reading of part and assembly drawings.

UNIT IV CAD PRACTICE (USING APPLICATION PACKAGES) **12 hours**

Drawing, Editing, Dimensioning, Plotting Commands, Layering Concepts, Hatching, Detailing, Assembly, Basic principles of GD&T (geometric dimensioning &tolerancing).

UNIT V ASSEMBLY DRAWING (MANUAL & USING APPLICATION PACKAGES) **12 hours**

Making free hand sketches of typical subassemblies-Plummer block, Screw jack, Lathe Tailstock, Universal Joint-Machine Vice-Stuffing Box-safety Valves-rolling element bearings, keyed joints, cotter joints, C clamp.

TOTAL: 60 hours

Text Books:

T1. Gopalakrishna K R, "Machine Drawing", Subhas Stores, Bangalore, 2017.
T2. CAD/CAM Manual, PSG College of Technology, Coimbatore, 2002.

Reference Books:

R1. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.

R2. BIS, SP: 46-2003 – "Engineering Drawing Practice for Schools and Colleges", New Delhi, 2003.

R3. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s. DPV Printers, Coimbatore, 1993.

R4. ASME Y 14.5M-1994, "Dimensioning and Tolerancing", ASME, New York, 1995.

Web Links:

1. https://nptel.ac.in/courses/112102101
2. **https://www.kprietdesignsociety.in/tutorials/anna-university-cad-lab-exercises**
3. **https://www.youtube.com/watch?v=cmR9cfWJRUU&t=32s**
4. **https://www.youtube.com/watch?v=4b1l3hbAylU**

COURSE OUTCOMES

CO1:	Discuss the code of practices and standard for engineering drawing.	**K2**
CO2:	Construct both 2-D of any components using Auto CAD software.	**K6**
CO3:	Construct assemblies such as vice, screw jack and tailstock of the lathe, etc. from the concepts learned using drafting software and create the different wireframe primitives using parametric representations	**K6**
CO4:	Apply geometric transformations on the created wireframe, surface and solid models.	**K4**

CO5:	Evaluate the validity of the sketch for later operations.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

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

Course Code	ELECTRONIC CIRCUITS AND DIGITAL ELECTRONICS LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- ✓ To provide students with an understanding of how to analyze, build, and troubleshoot digital circuits.
- ✓ To understand the relationships between combination logic and Boolean algebra, and between sequential logic and finite state machines;
- ✓ To analyze and design combinational logic circuits at the transistor level
- ✓ To design and implement the synchronous and asynchronous sequential circuits.

LIST OF EXPERIMENTS

1. Study of logic gates
2. Verification of Boolean logic theorems
3. Implementation of Half and Full Adder/Subtractor using logic gates.
4. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
5. Design and implementation of code converters using logic gates
   a. BCD to excess–3 code and vice versa
   b. Binary to gray and vice–versa
6. Design and verification of Magnitude Comparator using logic gates
7. Design of 16 bit odd/even parity checker generator using IC74180.
8. Design and implementation of Multiplexer and De-multiplexer using logic gates
9. Design and implementation of encoder and decoder using logic gates 10. Construction and verification of Mod N Counters
11. Implementation of SISO, SIPO, PISO and PIPO shift registers
12. Simulation of combinational circuits using VHDL programs
13. Simulation of sequential circuits using VHDL programs

COURSE OUTCOME:

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

CO1: Experiment with logic gates and verify truth table.

CO2: Examine and verify the working of combinational logic circuits. CO3: Analyze the working of Code Convertors using logic gates

CO4: Develop Shift registers & Counters using logic gates.

CO5: Evaluate the performance of combinational and logical circuits using VHDL programs.

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	-	-	-	2	2	2	2	2	2
CO2	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO3	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO4	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO5	2	2	2	2	1	-	-	-	2	2	2	2	2	2
	2	**2**	**2**	**2**	**1.8**	**-**	**-**	**-**	**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**
				✓	

SEMESTER IV

PC 09	MATHEMATICS-IV (STATISTICAL AND NUMERICAL METHODS)	L 3	T 1	P 0	C 4

COURSE OBJECTIVE:(Skill development)

- The objective is to develop the basic concepts of a few statistical and numerical methods familiar with the procedures for solving numerically different kinds of problems occurring in engineering.

UNIT I Testing of Hypothesis **12**

Sampling distributions – Large samples-Tests for single mean, Proportion, Difference of means Small samples – Tests for single mean, two mean and paired t-test-F-test – chi-square test for goodness of fit – Independence of attributes-Design of Experiments-Completely randomized design – Randomized block design – Latin square design.

UNIT II Correlation and Regression Analysis **12**

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 **12**

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

UNIT IV Interpolation, Numerical Differentiation and Numerical Integration **12**

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.

UNIT V 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 and Adams-Bashforth method (Simple problems).

TOTAL: 60 Hours

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Acquire the skill on testing of hypothesis

CO2: Familiar the concepts of correlation & regression

CO3: Attain the knowledge on solution of equations and eigen value problems

CO4: Describe the applications of interpolation, numerical differentiation and numerical integration.

CO5: Attain the knowledge on numerical solution of ordinary differential equations.

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2012.(For units 3, 4 and 5).
2. Johnson R.A. and Gupta C.B, "Miller and Freund's Probability and Statistics for Engineers", PearsonEducation, Asia, 7th edition, 2007 (For units 1 and 2).
3. Dr.Kandasamy .P, Dr. Thilagavathi, Dr. Gunavathi. K, "Statistics and numerical methods", S.Chand and company, first edition,2010.

REFERENCE BOOKS:

1. Chapra, S. C and Canale, R. P. “Numerical Methods for Engineers”, Tata McGraw-Hill, New Delhi, 7th Edition,2014.
2. Walpole R.E, Myers R.H, Myers S.L, and Ye. K, “Probability and Statistics for Engineersand Scientists”, Pearson Education, Asia , 9th edition, 2011

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	3	2
CO2	-	1	2	2	-	-	-	-	-	-	-	3	3	2
CO3	1	2	3	3	-	-	-	-	-	-	-	2	2	2
CO4	2	3	2	2	-	-	-	-	-	-	-	1	3	2
CO5	-	1	2	2	-	-	-	-	-	-	-	3	3	2

AssessmentMethods:

CAT1	CAT2	Model Exam	nd Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presen tion**

PC 09 **ELECTRICAL MACHINES AND POWER SYSTEMS**

L	T	P	C
3	1	0	3

COURSE OBJECTIVE:(Skill development)

- To study about basic electrical prime movers, electrical transmission and distribution systems.
- To study about the transformers
- To study about the different types of induction motors
- To study about the special machines
- To study about the power system

UNIT I D.C. MACHINES **12**

Constructional details – EMF equation – methods of excitation – self and separately excited generators – characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. motors

UNIT II TRANSFORMERS **12**

Constructional Details – Principle Of Operation – EMF Equation – Transformation Ratio – Transformer on No Load – Parameters Referred To HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load Test - 3- PHASE Transformers connections

UNIT III INDUCTION MOTORS **12**

Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – single-phase induction motors (only qualitative analysis).

UNIT IV SYNCHRONOUS AND SPECIAL MACHINES **12**

Construction of Synchronous machines-types – induced emf – brushless alternators – reluctance motor – stepper motor servo motor

UNIT V INTRODUCTION TO POWER SYSTEM **12**

Structure of electric power systems – generation, transmission, sub-transmission and distribution systems - EHVAC and EHVDC transmission systems – substation layout.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Understanding the principles of operations and characteristics of DC machines

CO2: Knowledge of electrical transformers and induction motors

CO3: Know about the different types of induction motors

CO4: Able to visualise the operation of synchronous motors stepper and sevo motors

CO5: Comprehending the power transmission and distributing systems

TEXT BOOKS :

1. Murugesh Kumar K. , „Electric Machines Vo I", Vikas Publishing House Pvt Ltd, 2010.
2. Murugesh Kumar K. , „Electric Machines Vol II", Vikas Publishing House Pvt Ltd, 2010
3. Mehta V.K. and Rohit Mehta, „Principles of Power System", S.Chand and Company Ltd, 2003

REFERENCES:

1. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, „Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.
2. Gupta J.B., „Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002
3. Kothari D.P. and Nagrath I.J., „Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.
4. Bhimbhra P.S. , „Electrical Machinery", Khanna Publishers, 2003.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	3	2	1	1	2	2	-	-	-	-	-	3	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	End SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	MCQ	Projects	Seminars	emonstration/Presentation

PC 09 KINEMATICS AND DYNAMICS OF MACHINCES

L	T	P	C
3	1	0	3

COURSE OBJECTIVE:(Skill development)

- To understand the basic knowledge about kinematics of machines.
- To understand the basic components and layout of linkages in the assembly of a system/ machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components

UNIT I KINEMATIC OF MACHINES 12

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 followers motion – circular arc and tangent cams

UNIT II GEARS and GEAR TRAINS 12

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

UNIT III FRICTION 12

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives

UNIT IV FORCE ANALYSIS 12

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

UNIT V BALANCING AND VIBRATION 12

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: the students be able to understand the basic knowledge of kinematics of machines

CO2: Students can able to apply fundamentals of mechanism for the design of new mechanisms

CO3: Able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions

CO4: Impart knowledge about the gears and gear trains.

CO5: Ability to analyse them for optimum design

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.

2. Ghosh. A, and A.K. Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	2	1	-	-	1	-	-	-	-	-	-	-	2	1
CO2	2	3	2	2	3	2	-	-	-	-	-	1	2	2
CO3	-	1	2	2	2	2	-	-	-	-	-	3	3	1
CO4	1	2	3	3	3	3	-	-	-	-	-	2	2	1
CO5	-	1	2	2	2	2	-	-	-	-	-	3	2	1

AssessmentMethods:

CAT1	CAT2	ModelExam	nd SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

PC 09 SENSORS AND INSTRUMENTATION

L	T	P	C
3	1	0	3

COURSE OBJECTIVE:(Skill development)

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I INTRODUCTION **12**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **12**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **12**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **12**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **12**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Familiar with various calibration techniques and signal types for sensors

CO2: Apply the various sensors in the Automotive and Mechatronics applications

CO3: Describe the working principle and characteristics of force, magnetic and heading sensors.

CO4: Understand the basic principles of various pressure and temperature, smart sensors

CO5: Ability to implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2. Hans Kurt Tonshoff (Editor), Ichiro , “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.

4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	3	2	1	1	2	2	-	-	-	-	-	3	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	nd SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presen tion**

PC 09 AUTOMATIC CONTROL SYSTEMS

L	T	P	C
3	1	0	4

COURSE OBJECTIVE:(Skill development)

- To study the basics of control system and its response .stability of mechanical and electrical systems . Use of MATLAB to design a stable control system.
- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response
- To impart knowledge about the frequency response and the stability of systems
- To introduce the state variable analysis method.

UNIT I INTRODUCTION **12**

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tachogenerator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions

UNIT II TIME DOMAIN ANALYSIS **12**

Standard Test signals – Time response of second order system - Time domain specifications – Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT III FREQUENCY DOMAIN ANALYSIS **12**

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT IV SYSTEM STABILITY **12**

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability – Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT V ROOT LOCUS METHOD **12**

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: To understand the basic of the control system

CO2: Ability to know about the time and frequency domain analysis

CO3: To know about the different stability of the systems

CO4: To expose students to the state space representation and its analysis.

CO5: To introduce non-linear systems and their control and to impart knowledge on advanced control techniques

TEXT BOOKS:

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.
2. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

REFERENCES:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.

2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.
3. Norman C. Nise S, “Control system Engineering“, John Wiley & Sons, Singapore, 2004.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	3	2	1	1	2	2	-	-	-	-	-	3	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	nd SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

PC 15	KINEMATICS AND DYNAMICS LABORATORY	L	T	P	C
		0	0	3	1

COURSE OBJECTIVE:(Skill development)

- To supplement the principles learnt in kinematics and dynamics of machinery.
- To understand howcertain measuring devices are used for dynamic testing.

STUDY EXPERIMENT

1. Study the Four bar chain mechanism
2. Study the Single slider crank mechanism
3. Study of Gear Mechanism

LIST OF EXPERIMENTS

1. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorised Gyroscope-Verification of laws -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system - spring mass system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficient for multi-degree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

TOTAL: 45 Hours

LIST OF EQUIPMENTS (For a batch of 30 students)

1. Cam analyzer.
2. Motorised gyroscope.
3. Governor apparatus - Watt, Porter, Proell and Hartnell governors.
4. Whirling of shaft apparatus.
5. Dynamic balancing machine.
6. Static and dynamic balancing machine.
7. Vibrating table
8. Vibration test facilities apparatus

COURSE OUTCOMES:

After successful completion of the Dynamics Laboratory course, the student will be able to

CO1: Understand the principles of kinematic and dynamic behavior of machine parts, Analyze how certain measuring devices are used for dynamic testing.

CO2: Demonstrate the effect of unbalances resulting from rotary motions. Understand vibrations in single and multi degree of freedom system

CO3: Able to learn working principle of the governor /gyroscope and demonstrate the effect of forces and moments on their motion, Evaluate cutting forces acting on machine elements using a dynamometer

CO4: Analyze moment of inertia by an oscillation method for connecting rod and flywheel, Understand determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.

CO5: Exposure on cam, governor, balancing masses and forces on various equipments based on theoretical and experimental methods.

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	2	1	-	-	1	-	-	-	-	-	-	-	2	3
CO2	1	2	3	3	3	3	-	-	-	-	-	2	2	1
CO3	2	1	-	-	1	-	-	-	-	-	-	-	3	2
CO4	2	3	2	2	3	2	-	-	-	-	-	1	2	3
CO5	1	2	3	3	3	3	-	-	-	-	-	2	3	2

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**
✓				

PC 09 **AUTOMATIC CONTROL SYSTEMS LABORATORY**

L	T	P	C
0	0	4	1

COURSE OBJECTIVE:(Skill development)

- To impart launch on experience in 56 characterizing different LIC.
- To train the students in MATLAB simulation of study the characteristics of LIC.

LIST OF EXPERIMENTS:

1 Characteristics and Applications of Op-Amp.
2. Waveform Generation using Op-Amp.
3. Performance characteristics of Voltage Regulator Ics.
4. Study of 555 Timer and 566 VCO.
5. Design and Implementation of Active Filters.
6. Determination of transfer function of DC servomotor.
7. Determination of transfer function of AC servomotor and study of synchros.
8. Time domain Response of first order and second order systems using MATLAB.
9. Frequency response of first and second order system using MATLAB.
10. Characteristics of PID controllers using MATLAB.

OUTCOMES:

CO1: Ability to design LIC and describe the characteristics.
CO2: Ability to attain knowledge about MATLAB

TOTAL : 60 PERIODS

Mapping of Program outcomes with course outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	O11	O12	SO1	SO2
CO1	2	1	-	-	1	-	-	-	-	-	-	-	2	3
CO2	1	2	3	3	3	3	-	-	-	-	-	2	2	1
CO3	2	1	-	-	1	-	-	-	-	-	-	-	3	2
CO4	2	3	2	2	3	2	-	-	-	-	-	1	2	3
CO5	1	2	3	3	3	3	-	-	-	-	-	2	3	2

Assessment Methods:

CAT1	CAT2	Model Exam	Semester Exams	Assignments
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**
				✓

MC 02	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE::(Skill development)

1. To inculcate the importance of environmental pollution, preservation of nature and environmental management for human welfare.
2. The student is expected to understand what constitutes the environment, what precious resources in the environment are, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.
3. The role of government and non – governmental organization in environmental managements.

UNIT I ENVIRONMENT, ECOSYSTEM 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 – Biogeographical 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, Changes 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 organization - 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: 30 Hours

COURSE OUTCOME

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

CO1: Understand the nature and facts about environment and implement scientific, technological, economic solutions to environmental problems and interrelationship between living organisms and environment.

CO2: Understand the integrated themes and biodiversity, natural resources, pollution control and waste management.

CO3: Analyze the importance of environment by assessing its impact on the human world.

CO4: Study the dynamic processes and understand the features of the earth's interior and surface; know the role of an individual in Conservation of Natural Resources and the various social issues.

CO5: Understand the role of government in solving the environmental problems and Know about Population Growth and variation among Nations.

TEXT BOOKS:

1. De AK, Environmental Chemistry, Wiley Eastern Ltd.
2. BharuchaErach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, India.
3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

REFERENCE BOOKS:

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.
2. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press.
3. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press 1140pgs.
4. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.
5. Miller TG, Jr. Environmental Science, Wadsworth Publishing CO. (TB)

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

CAT1	CAT2	ModelExam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**
			✓	

Semester V

PC 09 ROBOT DESIGN AND PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:(Skill development)

- To impart the area of Robot designing and programming in Robotic languages..

UNIT I INTRODUCTION **12**

Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II ROBOT KINEMATICS **12**

Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING **12**

Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES **12**

Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components

UNIT V ROBOT SENSORS AND ACTUATORS **12**

characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: To introduce the kinematic arrangement of robots and its applications in the area of manufacturing sectors

CO2: To expose to build a robot for any type of application

CO3: To know about the robo dynamics

CO4: To expose students to robot progamming

CO5: To introduce to the robot sensors and actuators

TEXT BOOKS

Lentin Joseph, "Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy",

Apress, 2018.

REFERENCES

1. Gordon Mair, 'Industrial Robotics', Prentice Hall (U.K.) 1988
2. Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 1996. 3. Saeed.B.Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002
4. Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition, 1988.

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/ Presentation**
			–	–

PC 09 CNC Machine And Metrology

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:(Skill development)

- Understand evolution and principle of CNC machine tools
- Write simple programs for CNC turning and machining centres
- Generate CNC programs for popular CNC controllers
- Describe about linear and angular measurements in metrology
- Study about the advancement in metrology

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 12

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways

UNIT II DRIVES AND WORK HOLDING DEVICES 12

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, moire fringe gratings, encoders, inductosysn, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines

UNIT III CNC PROGRAMMING 12

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT IV LINEAR AND ANGULAR MEASUREMENTS 12

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT V ROBOT SENSORS AND ACTUATORS 12

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Ability to know about the basic in CNC machineries

CO2: Evolution and principle of CNC machine tools and different measurement technologies

CO3: Able to write simple programs for CNC machinery

CO4: To impart knowledge about linear and angular measurements in metrology

CO5: Ability to know about the advancement in metrology

TEXT BOOKS:

1. "Mechatronics", HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.

3. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.

4. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

REFERENCES:

1. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.

2. Backwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2006.

3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000

4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.

5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/ Presentation**
			–	–

		L	T	P	C
PC 09	**DESIGN OF MACHINE ELEMENTS AND TRANSMISSION SYSTEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:(Skill development)

- To introduce students to the design and theory of common machine elements and
- To give students experience in solving design problems involving machine elements
- Write simple programs for CNC turning and machining centres

UNIT I INTRODUCTION **12**

Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Selection of Materials –Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria

UNIT II DETACHABLE AND PERMANENT JOINTS **12**

Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints

UNIT III SHAFTS AND COUPLING **12**

Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling

UNIT IV GEARS AND BELT DRIVES **12**

Design of Spur and Helical Gear drives-Design of Belt drives-Flat and V Belts

UNIT V SPRINGS AND BEARINGS **12**

Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: To formulate and analyze stresses and strains in machine elements subjected to various loads
CO2: To analyze and design structural joints such as Riveted joints, welded joints, Bolts
CO3: To analyze and design the components for power transmission like shaft and couplings
CO4: To analyze and design different types of gears and belts for engineering applications
CO5: To analyze and design mechanical springs and bearings.

TEXT BOOKS:

1. Joseph Edward Shigley, Charles R. Mischke " Mechanical Engineering Design", McGraw Hill, International Edition, 1992
2. Sharma. C.S. and Kamlesh Purohit, " Design of Machine Elements", Prentice Hall of India Private Limited, 2003

REFERENCES:

1. Bhandari. V.B., “Design of Machine Elements”, Tata McGraw-Hill Publishing Company Limited, 2003.
2. Robert L.Norton, “Machin Design – An Integrated Approach”, Prentice Hall International Edition, 2000.

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	MCQ	Projects	Seminars	emonstration/ Presentation
			–	–

PC 09 MICROCONTROLLER AND PLC

L	T	P	C
3	0	0	4

COURSE OBJECTIVE:(Skill development)

- To introduce the basic features, programming methods and applications of Micro controllers To give students experience in solving desig problems involving machine elements
- To study about programming in microcontroller
- Discuss different applications in microcontroller
- To know about the design of systems using PLC is introduced in detail
- To know about the applications in PLC

UNIT I INTRODUCTION TO MICROCONTROLLER 12

8051 Architecture:– Memory map - Addressing modes, I/O Ports –Counters and Timers – Serial data - I/O – Interrupts –Instruction set,, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions , Assembly Language Programming tools

UNIT II MICROCONTROLLER PROGRAMMING 12

8051 Assembly Language Programming- Block transfer, arithmetic operations, Code conversion, Time delay generation, Interrupt programming, Lookup table techniques

UNIT III MICROCONTROLLER APPLICATIONS 12

Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Analog to Digital and Digital to Analog Converter – Interfacing Hardware Circuit – Serial Data Communication –Network Configuration.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 12

Introduction — Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules , CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches - Latching relays,

UNIT V APPLICATIONS OF PROGRAMMABLE LOGIC CONTROLLERS 12

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: The students will learn the basic of microcontroller

CO2: The students will learn the programming in microcontroller

CO3: To know about the different applications of microcontroller

CO4: The students will learn about the design of systems using Programmable Logic Controllers

CO5: To know about the different applications of Programmable Logic Controllers

TEXT BOOKS:

1. Muhammad Ali Mazdi ,J.G.Mazdi & R.D.McKinlay "The 8051 Microcontroller& Embedded systems Using assembly & C " 2nd Edition Pearson Education , Inc ,2006
2. Udayasankara.v & Mallikarjunaswamy .M.S ,'8051 Microcontroller, Hardware, Software & Applications ,Tata McGraw Hill Education Pvt Limited. New Delhi ,2009.
3. Gary Dunning , 'Introduction to Programmable Logic Controllers'' Thomson Learning, 2001.

REFERENCES:

1. Singh. B.P., "Microprocessors and Microcontrollers", Galcotia Publications (P) Ltd, First edition, New Delhi, 1997.
2. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013
3. Valdes-Perez, Microcontrollers: Fundamentals and Applications with PIC, Taylor & Francis, Indian Reprint, 2013.
4. Bolton , "Programmable Logic Controllers" 5th Edition Newnes, ,2009

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/ Presentation**
			–	–

PC 09 CNC AND METROLOGY LABORATORY

L	T	P	C
3	0	3	1

COURSE OBJECTIVE:(Skill development)

- To impart knowledge in CNC programming for turning and milling operations
- To use measuring systems for the geometrical measurements of gears and threads
- To know the measurement of Taper Angle using Sine Bar
- To know about cutting tool geometry

LIST OF EXPERIMENTS:

1. Study of the CNC machine
2. Programming and simulation of a lathe using any CAM package
3. Programming and simulation of a machining centre using any CAM package
4. Programming and operation of a CNC Lathe
5. Programming and operation of a CNC machining centre
6. Measurement of Taper Angle using Sine Bar
7. Optical profile projector – study of profile of gear tooth, screw threads.
8. Tool maker's microscope – to study cutting tool geometry, screw threads.
9. Tool wear and surface finish measurement.
10. Dimensional measurement of machined components using, bore gauge, air gauge and Height master

OUTCOMES:

Ability to understand the features and operation of CNC machines.
Ability to prepare CNC program from the component drawings
Understanding the usage of profile projectors and tool makers microscopes.

TOTAL : 60 PERIODS

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	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	2	-	-	-	-	-	-	-	-	2	-
CO3	3	2	3	2	-	-	-	-	-	-	-	-	2	-
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	3
CO5	3	-	3	-	-	-	-	-	-	-	-	-	-	-

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
			–	
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/ Presentation**
				–

Semester VI

PC 09 FLUID POWER AUTOMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:(Skill development)

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using various design procedures.

UNIT I INTRODUCTION **12**

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENT **12**

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis

UNIT III CONTROL AND REGULATION ELEMENTS **12**

Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics electro hydraulic servo valves-Different types-characteristics and performance

UNIT IV CIRCUIT DESIGN **12**

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS **12**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors. .

TOTAL: 45 PERIODS

Test Book

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
2. Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967.

3. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978

REFERENCES:

1. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
2. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan rem, 1994.
3. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979 4. W.Bolton, Mechatronics, Electronic

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: The students will learn the basic of Symbols of Hydraulics & Pnuematics

CO2: The students will learn the Actuating Devices

CO3: To know about the different types of values and controlling units

CO4: The students will learn Hydraulic circuits

CO5: To know about the different applications of Programmable Logic Controllers

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	MCQ	Projects	Seminars	emonstration/ Presentation
			–	–

PC 09 AUTOMATION SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVE:(Skill development)

- To know about the basic concepts in industrial automation
- To design automated systems.
- To know about transfer lines and automated assembly
- Be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
- To know about the advancement in hydraulics and pneumatics

UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 12

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation

UNIT II TRANSFER LINES AND AUTOMATED ASSEMBLY 12

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing

UNIT III DESIGN OF MECHATRONIC SYSTEMS 12

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system

UNIT IV PROGRAMMABLE AUTOMATION 12

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems

UNIT V DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY 12

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001.
2. Bolton W, “Mechatronics“, Pearson Education, 1999.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill , New York, USA. 2000.
2. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, "Product Design for manufacture and Assembly", CRC Press, 2011

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Knowledge of industrial automation by transfer lines and automated assembly lines.

CO2: Ability to design an automated system

CO3: Understanding of automated controls using pneumatic and hydraulic systems

CO4: Ability to understand the electronic control systems in metal machining and other manufacturing processes.

CO5: To understand advancement in hydraulics and pneumatics systems

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	MCQ	Projects	Seminars	emonstration/ Presentation
			–	–

PC 09	EMBEDDED CONTROLLERS AND REAL TIME OPERATING SYSTEMS	L	T	P	C
		3	0	0	4

COURSE OBJECTIVE:(Skill development)

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems
- Learn about some real time operating systems

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 12

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 12

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 12

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE

UNIT IV SYSTEM DESIGN TECHNIQUES AND NETWORKS 12

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors

UNIT V CASE STUDY IN EMBEDDED SYSTEMS 12

Data compressor - Alarm Clock - Audio player - Software modem-Digital still camera – Telephone answering machine-Engine control unit – Video accelerator

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001.
2. Bolton W, “Mechatronics“, Pearson Education, 1999.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications” , McGraw Hill , New York, USA. 2000.
2. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, “Product Design for manufacture and Assembly”, CRC Press, 2011

COURSE OUTCOMES:

After successful completion of the Industrial Safety course, the student will be able to

CO1: Describe the architecture and programming of ARM processor

CO2: Explain the basic concepts of embedded systems and real time Operating system design

CO3: Use the system design techniques to develop software for embedded systems

CO4: Differentiate between the general purpose operating system and the real time operating system

CO5: Model real-time applications using embedded-system concepts

.

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	CAT 2	Model Exam	SemesterExams	Assignments
–	–	–	–	–
Quiz	MCQ	Projects	Seminars	emonstration/ Presentation
			–	–

PC 09	AUTOMATION SYSTEM DESIGN LABORATORY	L	T	P	C
		3	0	3	1

COURSE OBJECTIVE:(Skill development)

- To illustrate the design and simulation of multiple actuator systems using pneumatic, electropneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems.
- To design a system using PNEUMOSIM software
- To design a Microcontroller kit with stepper motor and drive circuit using LABVIEW software
- To expose the students in sensors/actuators interfaced with computers.
- To design a circuit using stepper motor

LIST OF EXPERIMENTS:

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

CO1: Able to design and layout multiple actuator systems with start shop and emergency modules

CO2: Able to develop Ladder logic for electro-pneumatic actuator systems

CO3: Acquiring skill of interfacing different sensors like LVDT, ultrasonic and touch sensors

CO4: Ability to develop control system for stepper motors

CO5: Ability to design Microcontroller kit with stepper motor and drive circuit using LABVIEW software

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT 1	**CAT 2**	**Model Exam**	**SemesterExams**	**Assignments**
			–	
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/ Presentation**
				–

22EBME7C	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

OURSE OBJECTIVE: (Employability)

- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

UNIT I COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing 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, wire frame 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 a 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 – role of G.T in CAD/CAM Integration – part families- classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing. Process planning - 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

COURSE OUTCOMES:

After successful completion of the Computer Integrated Manufacturing course, the student will be able to

CO1: Understand the basic Concepts of drafting, designing facility of CAD package and CAD drawing command structure.

CO2: Identify and classify the various communication system used in Computer integrated manufacturing.

CO3: Understand the process planning and group technology.

CO4: Know the various Shop Floor Control and FMS.

CO5: Understand the Computer Aided Planning and Control.

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", Pearson Education India, 2006

2. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.

3. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.

4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. Ltd., 2005.

5. YoremKoren, "Computer Integrated Manufacturing", McGraw Hill, 2005.

P N Rao, "CAD/CAM Principles and Applications", TMH Publica

Mapping of Program outcome with course outcome based on attainment levels

CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	3	2	2	3	2	-	-	-	-	-	1	2	1
CO2	3	2	1	1	2	1	-	-	-	-	-	-	2	1
CO3	-	1	2	2	2	2	-	-	-	-	-	3	1	3
CO4	1	2	3	3	3	3	-	-	-	-	-	2	2	1
CO5	3	2	1	1	2	1	-	-	-	-	-	-	3	3

Professional Elective Courses

Course Code	VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the
- circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9 hours

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9 hours

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9 hours

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

Timing Issues : Timing Classification Of Digital System, Synchronous Design

UNIT IV IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9 hours

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9 hours

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability , Boundary Scan.

TOTAL : 45 hours

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson , 2017 (UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits:A Design perspective”, Second Edition , Pearson , 2016.(UNIT III,IV).

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REFERENCES

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits:Analysis & Design”,4th edition McGraw Hill Education,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

CourseOutcome

CO1:	Realize the concepts of digital building blocks using MOS transistor	**K3**
CO2:	Study the fundamentals of CMOS circuits and its characteristics	**K2**
CO3:	Learn the design and realization of combinational & sequential digital circuits	**K3**

CO4:	Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed	**K4**
CO5:	Learn the different FPGA architectures and testability of VLSI circuits.	**K4**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

CAT1	CAT2	Model Exam	Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives

- Introduce the principle, programming technique with instrument interfaces.
- Applications of virtual instruments.
- understand the basics of data acquisition
- introduced in mechatronics systems.

UNIT I INTRODUCTION TO MOS TRANSISTOR **9 hours**

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data - flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS **9 hours**

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III SEQUENTIAL CIRCUIT DESIGN **9 hours**

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation

UNIT IV IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM **9 hours**

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING **9 hours**

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

TOTAL : 45 hours

TEXT BOOK:

1. Gupta ," Virtual Instrumentation Using Lab view" 2nd Edition, Tata McGraw-Hill Education, 2010
91

REFERENCES:

1. Gary Jonson, "Labview Graphical Programming", Fourth Edition, McGraw Hill, New York, 2006
2. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition & Process Control", Second Edition, Instrument Society of America, 1994.
3. Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 1998

CourseOutcome

CO1:	CO1: Understand the evolution, advantages, techniques, architecture and applications of visual instrumentation	**K3**
	Acquiring knowledge on VI programming techniques	**K2**
CO3:	Study about the basics of data acquisition	**K3**
CO4:	Understanding the concept of common instrument interfaces with industrial applications	**K4**
CO5:	Study about the use of analysis tools with various applications	**K4**

Mapping of Program outcomes with course outcomes

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

Assessment Methods:

CAT1	CAT2	Model Exam	Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	INDUSTRIAL DESIGN AND APPLIED ERGONOMICS	L	T	P	C
		3	0	0	3

Course Objectives

- To explain the general principles that governs the interaction of humans in their working environment
- To improve improving worker performance and safety.
- To know about the environmental conditions in the industry.
- To know about bio thermodynamics and bioenergetics
- To know about the human factors in industrial aspects

UNIT I INTRODUCTION **9 hours**

Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications.

UNIT II HUMAN OUTPUT AND CONTROL **9 hours**

Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

WORKPLACE DESIGN:

Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, and fatigue

UNIT III ENVIRONMENTAL CONDITIONS **9 hours**

Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts.
BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS **9 hours**

Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

UNIT V HUMAN FACTORS APPLICATIONS **9 hours**

Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA‟s approach, virtual environments.

TOTAL : 45 hours

TEXT BOOK:

1. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

REFERENCES:

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Mayall W H, “Indus trial Design for Engineers”, London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.

CourseOutcome

CO1:	Know about ergonomic principles to design workplaces	**K3**
CO2	improve human performance	**K2**
CO3:	judge the environmental conditions in the work place.	**K3**
CO4:	know about biothermodynamics and bioenergetics	**K4**
CO5:	implement latest occupational health and safety to the work place.	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

Course Objectives

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence

UNIT I INTRODUCTION **9 hours**

History, state of the art**,** Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II HUMAN OUTPUT AND CONTROL **9 hours**

Planning withforward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world

UNIT III ENVIRONMENTAL CONDITIONS **9 hours**

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS **9 hours**

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V HUMAN FACTORS APPLICATIONS **9 hours**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL : 45 hours

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approch”, Pearson Education, India2003.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison-Wesley, 2002.

REFERENCE:

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.

CourseOutcome

CO1:	Identify problems that are amenable to solution by AI methods.	**K3**
CO2	Identify appropriate AI methods to solve a given problem.	**K2**
CO3:	Formalise a given problem in the language/framework of different AI methods.	**K3**
CO4:	Implement basic AI algorithms.	**K4**
CO5:	Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.	**K4**

Mapping of Program outcomes with course outcomes

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

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	SPECIAL MACHINES AND CONTROLLERS	L	T	P	C
		3	0	0	3

Course Objectives

- To know about stepper motors.
- To know about switched reluctance motors
- To know about permanent magnet brushless d.c. Motors
- To know about permanent magnet synchronous motors
- To know about linear motors

UNIT I INTRODUCTION 9 hours

Types - Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque predictions – Drive systems and circuit for open loop and closed loop control of stepper motor.

UNIT II HUMAN OUTPUT AND CONTROL 9 hours

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Logic Controller – Sensorless Control of SR motor - Applications.

UNIT III ENVIRONMENTAL CONDITIONS 9 hours

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS 9 hours

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – Applications.

UNIT V HUMAN FACTORS APPLICATIONS 9 hours

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types–Applications SERVOMOTORS: Servomotor – Types – Constructional features, principle of operation - control applications

TOTAL : 45 hours

TEXT BOOKS:

1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India, 2009.
2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989

REFERENCES:

1. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
2. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989 .
3. Naser A and Boldea L,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
4. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.
5. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC, 2001

CourseOutcome

CO1:	Understanding principles of operation, types and applications of stepper motors	**K3**
CO2	Understanding principles of operation, types and applications of switched reluctance motors	**K2**
CO3:	Knowledge in evaluating the performance of dc motors	**K3**
CO4:	To evaluate knowledge in permanent magnet synchronous motors.	**K4**
CO5:	Ability to understand the working and applications linear motors and servo motors.	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	ADVANCED CONTROL SYST	L	T	P	C
		3	0	0	3

Course Objectives

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN 9 hours

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II HUMAN OUTPUT AND CONTROL 9 hours

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III ENVIRONMENTAL CONDITIONS 9 hours

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS 9 hours

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti‟s equation – Application examples.

UNIT V HUMAN FACTORS APPLICATIONS 9 hours

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter-Application examples..

TOTAL : 45 hours

TEXT BOOKS

1. Mohandas K. P., “Modern Control Engineering”, Sanguine Technical Publishers, 2006
2. Thaler G.J., “Automatic Control Systems”, Jaico Publishing House, 1993
3. Gopal ,M. Modern control system theory, New Age International Publishers, 2002.

REFERENCES

1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group 2011.
2. Ashish Tewari, „Modern control Design with Matlab and Simulink, John Wiley, New Delhi, 2002.
3. Ogata K., „Modern Control Engineering‟, 4th edition, PHI, New Delhi, 2002.
4. Glad T. and Ljung L. “Control theory –Multivariable and Non-linear methods”, Taylor & Francis, 2002
5. Naidu D.S., “Optimal Control Systems” First Indian Reprint, CRC Press, 2009.

CourseOutcome

CO1:	Design in state variable form	**K3**
CO2	Knowledge in phase plane analysis.	**K2**
CO3:	To describe function analysis.	**K3**
CO4:	Know the design of optimal controller.	**K4**
CO5:	Know about the design of optimal estimator including kalman filter	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

Course Objectives

- To learn about basis of nanomaterial science
- Preparation method
- Types and application.

UNIT I INTRODUCTION **9 hours**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION **9 hours**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

UNIT III NANOMATERIALS **9 hours**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications- Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES **9 hours**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS **9 hours**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 hours

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. AkhleshLakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

CourseOutcome

CO1:	Will familiarize about the science of nanomaterials	**K3**
CO2	Will demonstrate the preparation of nanomaterials	**K2**
CO3:	Will develop knowledge in characteristic nanomaterial	**K3**
CO4:	Will know the development techniques	**K4**
CO5:	Will know the applications of Nano in Battery Manufacturing	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

Assessment Methods:

CAT1	CAT2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**

Course Code	INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To know about material handling in a system.

UNIT I INTRODUCTION 9 hours

Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

UNIT II ROBOTS FOR INSPECTION 9 hours

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

UNIT III OTHER APPLICATIONS 9 hours

Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

UNIT IV END EFFECTORS 9 hours

Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.

UNIT V MATERIAL HANDLING 9 hours

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology

TOTAL : 45 hours

TEXT BOOKS:

1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An integrated Approach” Prentice HallIndia, New Delhi, 2001.
2. Mikell P. Groover,”Automation, Production Systems, and Computer Integrated Manufacturing“, 2nd Edition, John Wiley & sons, Inc, 2007

REFERENCES:

1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994

CourseOutcome

CO1:	Learn about the basic concepts, parts of robots and types of robots.	**K3**
CO2	To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.	**K2**
CO3:	Ability in selecting the required robot	**K3**
CO4:	Know various applications of robots	**K4**
CO5:	Apply their knowledge in handling the materials	**K4**

Mapping of Program outcomes with course outcomes

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

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

- To provide the overview of embedded system design principles
- To understand the concepts of real time operating systems
- To provide exposure to embedded system development tools with hands on experience in using basic programming techniques.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 7 hours

Overview of embedded systems, embedded system design process, challenges - common design metrics and optimizing them. Hardware - Software code sign embedded product development.

UNIT II REAL TIME OPERATING SYSTEM 9 hours

Real time operating systems Architecture - Tasks and Task states - Tasks and Data - Semaphone and shared data - Message queues, mail boxes and pipes - Encapsulating semaphores and queues - interrupt routines in an RTOS Environment. Introduction to Vx works, RT Linux.

UNIT III PIC MICROCONTROLLER 9 hours

Architecture - Instruction set - Addressing modes - Timers - Interrupt logic - CCP modules - ADC

UNIT IV EMBEDDED NETWORKING 7 9 hours

Introduction - CAN BUS - I2C - GSM - GPRS - Zig bee.

.

UNIT V EMBEDDED PROGRAMMING 9 hours

I/O Programming
Interrupts and Timer application
Interfacing Keypad
Interfacing LCD
Interfacing ADC/DAC

TOTAL : 45 hours

TEXT BOOKS:

1. Frank Vahid, Tony John Givargis, Embedded System Design: A Unified Hardware/ Software Introduction - Wiley & Sons, Inc.2002 .
2. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata Mc Graw Hill, 2011
3. John B. Peatman, "Design with PIC Microcontrollers" Prentice Hall, 2003.

REFERENCES

1. Steve Heath, 'Embedded System Design', II edition, Elsevier, 2003.
2. David E. Simon, "An embedded software primer", Addison – Wesley, Indian Edition Reprint (2009).
3. Robert Foludi "Building Wireless Sensor Networks", O'Reilly, 2011.

CourseOutcome

CO1:	Learn about the Embedded system.	**K3**
CO2	Learn about real time operating system.	**K2**
CO3:	Learning of PI Microcontroller	**K3**
CO4:	Know Embedded Networks	**K4**
CO5:	Programming in Embedded system	**K4**

Mapping of Program outcomes with course outcomes

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

CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	-	3	3

AssessmentMethods:

CAT1	**CAT2**	**ModelExam**	**SemesterExams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	WIRELESS SENSORS NETWORKS FOR ROBOTICS	L	T	P	C
		3	0	0	3

Course Objectives

- To know the basic knowledge about wireless sensor networks
- To impart knowledge in networking using sensors
- To know about the tools used in networking
- To understand the basic in wireless architecture
- To know about the different techniques used in networking

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 7 hours

Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks.

UNIT II ARCHITECTURES 9 hours

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT III NETWORKING SENSORS 9 hours

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT 9 hours

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9 hours

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

TOTAL : 45 hours

TEXTBOOKS

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

REFERENCES

1. KazemSohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

CourseOutcome

CO1:	Ability to know about the different techniques used in networking	**K3**
CO2	To expose basic knowledge about wireless sensor networks	**K2**
CO3:	Ability to know about the tools in networking	**K3**
CO4:	Understand the basic in wireless architecture	**K4**
CO5:	Ability to know about the protocols used in networking	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 7 hours

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS I 9 hours

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS II 9 hours

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.
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UNIT IV MICROMACHINING 9 hours

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9 hours

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 hours

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.

2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.
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REFERENCES:

1. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
3. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000
4. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

CourseOutcome

CO1:	Ability to understand and apply basic science, circuit theory	**K3**
CO2	Ability to understand Electro-magnetic field theory	**K2**
CO3:	Ability to understand control theory and apply them to electrical engineering problems	**K3**
CO4:	Ability to understand and analyse, linear and digital electronic circuits	**K4**
CO5:	Ability to know about the Polymer And Optical Mems	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	**CAT2**	**ModelExam**	**SemesterExams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	DIGITAL SIGNAL PROCESSORS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives

- To understand the concept of information, types of channels
- To understand the capabilities of various source coding theorems and the fundamental limit of transmission over the channel.
- To understand the various concepts of signal processing with its applications.
- To understand the capabilities of various channel coding theorems.
- To develop the knowledge on pass band communication and spread spectrum.

UNIT I ARCHITECTURE OFTMS320C5X 7 hours

Introduction -Bus structure-Central Arithmetic Logic unit(CALU)-Auxiliary Register ALU(ARAU)-Indexregister(INDX)-Auxiliary register compare register-Block move address register-,Block repeat registers-parallel logic unit-memory mapped registers-program controllers-on chip features

UNIT II TMS320C5X PROGRAMMING 9 hours

Assembly language syntax-Addressing modes, Load/store instructions-Addition/subtraction instructions-Move instructions-Multiplication instruction-NORM instruction-Program control instructions-Peripheral instructions-Instruction Pipelining inC5x-Pipeline structure, Pipeline operation-Normal pipeline Operation.

UNIT III APPLICATIONS 9 hours

C50 based starter kit-Programs for familiarization of the addressing modes-Program for familiarization of Arithmetic Instructions-Programs in C5x for Processing Real time signals.

UNIT IV ARCHITECTURE OF TMS320C54X 9 hours

Introduction-Architecture-Buses-Memory Organization-CPU-ALU-Barrel shifter-Multiplier/Adder unit-Compare, Select and store unit-Exponent Encoder-C54X pipeline-On chip Peripherals-Data Address Generation logic-Program address generation logic. 109

UNIT V TMS320C54X PROGRAMMING 9 hours

Data Addressing-Arithmetic instructions-Move instructions-Load/Store instructions-Logical instructions-Control instructions-Conditional store instructions-Repeat instructions-I/o instructions-Bit manipulation instructions-parallel instructions-special instructions-Application programs.

TOTAL : 45 hours

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

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REFERENCES:

1. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
3. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000
4. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

CourseOutcome

CO1:	Know about the various concepts of signal processing with its applications Discuss the representation of signals and the process of sampling, quantization	**K3**
CO2	Coding that are fundamental to the digital transmission of analog signals.	**K2**
CO3:	Know about the capabilities of various source coding theorems and the fundamental limit of transmission over the channel.	**K3**
CO4:	Design the baseband and band pass signal transmission and reception techniques.	**K4**

CO5:	Explain error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	**CAT2**	**ModelExam**	**SemesterExams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	INTERNET TOOLS AND JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

Course Objectives

- Learn about the various tools used in internet
- Learn Java Programming.
- Understand different Internet Technologies and the way to handle it.
- Be familiar with client – side programming and server – side programming.
- Learn to develop web applications

UNIT I INTERNET TOOLS **7 hours**

Major Internet Services – Net Telephony – Internet Relay Chat – Newsgroups – File Transfer Protocol (FTP) – Remote Login – Telnet, Gopher, and Veronica Clients OBJECT ORIENTATION IN JAVA:Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings -Input/Ouput.-Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword -object based Vs oriented programming.- -Inheritance-Reusability - Composing class.

UNIT II ABSTRACT FUNCTIONS AND PACKAGES **9 hours**

Abstract classes - Abstract Functions – Method Overloading and Method Overriding- Wrapper Classes. Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces.

UNIT III EXCEPTION HANDLING **9 hours**

Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses. MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock..

UNIT IV I/O, APPLETS **9 hours**

I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods.- GUI Components - Applets - Java Scripts – AWT / Swings.

UNIT V INTRODUCTION TO NETWORK PROGRAMMING **9 hours**

Fundamentals - Internet Addresses - Internet Protocols - DNS - Internet Services - Socket programming, UDP, TCP. JAVA DATABASE PROGRAMMING**:** JDBC –Database Connection and Table Creation – Execution of Embedded SQL Statements - ResultSet and ResultSetMetaData – Examples.

TOTAL : 45 hours

TEXT BOOKS:

1. Patrick Naughton and Herbert Schildt, "JAVA - The Complete Reference", Tata McGraw Hill, 1997.
2. Deitel and Deitel, "JAVA - How to Program", Prentice Hall International Inc, 2003.

REFERENCES:

1. William Stanek and Peter Norton, "Peter Norton's Guide to Java Programming",Tech Media Publications, 1997.
2. Mark Grand, "JAVA Language Reference", O'Reilly & Associates Inc., 1997.
3. Horstmann and Cornell, “Core Java”, Pearson Education, 2001.
4. Kennath Litwak, “Pure Java 2: A Code-Intensive Premium Reference”, Tech Media Publications, New Delhi, 2000
5. James K L,” The Internet: A Users Guide”, Prentice Hall of India, New Delhi, 2003.

CourseOutcome

CO1:	Implement Java programs and to create a basic website using HTML and Cascading Style Sheets	**K3**
CO2	Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms	**K2**
CO3:	Design rich client presentation using AJAX.	**K3**
CO4:	Design and implement simple web page in PHP, and to present data in XML format.	**K4**
CO5:	Design and implement server side programs using Servlets and JSP.	**K4**

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	3	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	3	-	-	-	-	-	2	2	3

AssessmentMethods:

CAT1	CAT2	ModelExam	SemesterExams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**emonstration/Presentation**

Course Code	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

Course Objectives

- Applying the concept of CIM & Automation and analyzing the Manufacturing process.
- Applying the Manufacturing knowledge in Process Planning and will gain Confidence in controlling production.
- Analyzing cellular manufacturing and converting conventional system to FMS.
- Selecting and applying industrial Robots for industries usages.

UNIT I INTRODUCTION **9 hours**

Various phases in Product Design and CAD, CAM, Concepts of CAD/CAM – CIM concepts and elements – Types of production – Manufacturing Metrics and Economics – Production Performance Metrics – Manufacturing Cost - Simple problems – Basic Elements of an Automated system – Advanced Automation Functions - Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING & CONTROL SYSTEM AND COMPUTER AIDED PROCESS PLANNING **9 hours**

Production planning and Control System - Aggregate Production Planning and Master Production Schedule – Material Requirement Planning (MRP I) – Simple Problems –Capacity Planning – Shop Floor Control – Inventory Control – EOQ, WIP costs & Inventory Holding Costs - Simple Problems – Introduction to Manufacturing Resource Planning (MRP II) & Enterprise Resource Planning (ERP) - Process planning – Manual Process Planning and case studies Computer Aided Process Planning (CAPP)

UNIT III GROUP TECNOLOGY AND CELLULAR MANUFACTURING **9 hours**

Group Technology(GT) - Part Families – Parts Classification and coding – Simple Problems in OPITZ Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing –Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Performance Metrics in Cell Operation – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **9 hours**

Types of FMS & Flexibility – FMS Components – FMS Application & Benefits – FMS Planning and Implementation Issues – Quantitative analysis of Bottleneck Model on simple problems in FMS - Alternative Approach in Flexible Manufacturing - Automated Guided Vehicle System (AGVS) – Types of AGVS - Applications – Vehicle Guidance technologies –Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS **9 hours**

Robot Anatomy and Related Attributes – Classification - Control systems – End Effectors –Sensors – Applications – Basics of Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 hours

Text Books:

1. Mikell .P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, PEARSON, 2018.
2. Kant Vajpayee S., “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003

Reference Books:

1. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
2. Groover Mikell P. & ZIMMERS E., “CAD/CAM – Computer Aided Design and Manufacturing”, PEARSON, 2018.
3. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.
4. Radhakrishnan P., Subramanyan S. and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.
5. Rao. P. N., Tewari. N. and Kundra. T.K., “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

Web Links:

1. https://www.youtube.com/watch?v=9fqygvj-O2s&t=11s
2. https://www.youtube.com/watch?v=tiarT1YS-lM
3. https://www.youtube.com/watch?v=YGtg4OPSFhc

COURSE OUTCOMES

CO1:	Understand the basic concepts of CAD, CAM and computer integrated manufacturing systems.	**K2**
CO2:	Summarize the production planning and control and computerized process planning.	**K2**
CO3:	Differentiate the different coding systems used in group technology.	**K3**
CO4:	Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system.	**K4**
CO5:	Explain the basic components of robotics and various applications of the robots.	**K4**

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	-	-	-	-	-	-	-	2	1
CO2	3	2	1	1	2	-	-	-	-	-	-	-	3	2
CO3	1	2	3	3	3	-	-	-	-	-	-	2	1	2
CO4	1	2	3	3	3	-	-	-	-	-	-	2	1	2
CO5	-	1	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**
√			√		

15DBME75	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

UNIT I INTRODUCTION 9

Overview – History - Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II CAD & REVERSE ENGINEERING 9

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 9

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies.

TOTAL : 45 Hours

COURSE OUTCOMES:

CO1:	Understand why the Advanced/Additive manufacturing (AM) has become one of the most important technology trends in decades of product development and innovation	**K2**
CO2:	Capabilities and materials available	**K2**
CO3:	Understand the various software tools and reverse engineering techniques	**K3**
CO4:	Understand the manufacturing devices and processes.	**K4**
CO5:	Understand the powder based additive manufacturing system	**K4**

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

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

ASSESSMENT METHODS:

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

FINITE ELEMENT METHODS

L	T	P	C
3	0	0	3

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS 9

Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement –comparisons – piecewise continuous trial functions- example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element.

UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 9

General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions –element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.

UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 9

Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly –example problems in plane stress, plane strain and axisymmetric applications.

UNIT IV DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD 9

Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods.

UNIT V APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS 9

One dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions – Applications to heat transfer in 2-Dimension – Application to problems in fluid mechanics in 2-Dimensional.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Finite Element Analysis course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Formulate the finite element mathematical modeling concepts for boundary value engineering Problems.	**K6**
CO2	Analyze the problems in one dimensional structures including trusses, beams and frames	**K4**
CO3	Analyze the problems in two dimensional structures including plain stress, plane strain and axisymmetric applications	**K4**
CO4	Evaluate the solution of Eigen value, longitudinal and transverse vibration problems.	**K5**
CO5	Apply the finite element method to solve two dimensional problems in the applications of fluid mechanics and heat transfer.	**K6**

TEXT BOOK:

1. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007. ISBN-978-203-2315-5

REFERENCE BOOKS:

1. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions (Engineering Mechanics Series), 1993.
2. Chandrupatla&Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions.
3. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005.
4. Cook,Robert.D., Plesha,Michael.E&Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2004.

TEXT BOOK:
1. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007. ISBN-978-203-2315-5
REFERENCE BOOKS:
1. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions (Engineering Mechanics Series), 1993.
2. Chandrupatla&Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions.
3. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005.
4. Cook,Robert.D., Plesha,Michael.E&Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2004.

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

18DBME51	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system.

UNIT I VEHICLE STRUCTURE AND ENGINES 9

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

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system.

UNIT III TRANSMISSION SYSTEMS 9

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

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS) and Traction Control

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas. Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles-Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

Note: *Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.*

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Automobile Engineering course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE

		LEVEL
CO1	Explain the vehicle construction and engines in automobiles.	**K5**
CO2	Demonstrate the fuel injection, ignition systems and starting systems.	**K3**
CO3	Function of the transmission and cooling systems.	**K4**
CO4	Discuss the steering systems, braking systems and suspension systems.	**K6**
CO5	Discuss the IC engine emissions and alternative fuels and their conversion kits used in automobile.	**K6**

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering Vol 1 & 2 ", Standard Publishers, Seventh Edition, 1997, New Delhi
2. Jain,K.K., and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002

REFERENCES:

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.
2. Joseph Heitner, "Automotive Mechanics", Second Edition, East-West Press, 1999.
3. Martin W. Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals", The Good heart – Will Cox Company Inc, USA, 1978.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
5. R. Pugazhenthi, et.al., "Automobile Engineering", sams publications, 2015.
6. Ganesan V." Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill, 2007.

Mapping of Program outcome with course outcome based on attainment levels

CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	2	3	3	3	3	1	-	2	-	2	2	3	3
CO2	3	2	1	1	2	1	3	-	-	-	-	-	3	3
CO3	2	3	2	2	3	2	2	-	1	-	1	1	2	3
CO4	-	1	2	2	2	2	-	-	3	-	3	3	1	2
CO5	-	1	2	2	2	2	-	-	3	-	3	3	3	2
Average	2	1.8	2	2	2.4	2	2	-	2.2	-	2.2	2.2		

OPEN ELECTIVE COURSES

18GBME51	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.
- To enable the students 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 INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 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.

UNIT III ORGANISING 9

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

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication –communication and IT.

UNIT V CONTROLLING 9

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

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Principles of Management course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Discuss the management roles and skills and evolution of the management.	**K6**
CO2	Analyze the planning and organizing system of the management.	**K4**
CO3	Discuss directing and controlling system of the management	**K6**
CO4	Develop engineering ethics and improve human values	**K6**
CO5	Explain safety responsibilities and environmental ethics	**K5**

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.
4. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME51				Semester							
Subject Name	PRINCIPLES OF MANAGEMENT											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	2	-	2	-	2	3	3	3	3
CO2	-	-	2	2	-	2	2	2	1	1	1	1
CO3	-	-	2	2	-	2	-	2	3	3	3	3
CO4	-	-	2	2	-	2	-	2	3	3	3	3
CO5	-	-	3	3	-	3	1	3	2	2	2	2
Average	-	-	2.2	2.2	-	2.2	1.5	2.2	2.4	2.4	2.4	2.4

PSOs matrices of courses selected

Subject Code	18GBME51	Semester	
Subject Name	PRINCIPLES OF MANAGEMENT		
CO	PSO1	PSO2	
CO1	2	1	
CO2	2	3	
CO3	3	2	
CO4	2	1	
CO5	2	3	
Average	2.2	2	

18GBME52 **OPERATIONS RESEARCH** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS **15**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS **8**

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 **6**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice

UNIT IV QUEUEING MODELS **6**

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 **10**

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

COURSE OUTCOMES:

After successful completion of the Operations Research course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Develop the operational research models for the verbal description of the real system of linear models.	**K6**
CO2	Understand the mathematical optimization tools to solve optimization problems.	**K4**
CO3	Use mathematical and simulation software to solve the proposed models.	**K6**
CO4	Understand the transportation & network models and various techniques of operations research.	**K6**
CO5	Understand the techniques used in operations research to solve the real life problem in minimizing the industrial problems suggest an optimum solution.	**K5**

TEXT / REFERENCE BOOKS:

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005

2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.
3. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
4. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
5. Philip D.T. and Ravindran A., "Operations Re search", John Wiley, 1992.
6. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
7. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME52				Semester							
Subject Name	Operations Research											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	1	2	2	1	2	0	2	3	3	3	3
CO2	2	3	2	2	3	2	2	2	1	1	1	1
CO3	0	1	2	2	1	2	0	2	3	3	3	3
CO4	0	1	2	2	1	2	0	2	3	3	3	3
CO5	1	2	3	3	2	3	1	3	2	2	2	2
Average	0.6	1.6	2.2	2.2	1.6	2.2	0.6	2.2	2.4	2.4	2.4	2.4

PSOs matrices of courses selected

Subject Code	18GBME52	Semester	
Subject Name	Operations Research		
CO	PSO1	PSO2	
CO1	2	3	
CO2	1	2	
CO3	3	1	
CO4	2	3	
CO5	1	1	
Average	1.8	2	

18GBME53 **HUMAN RIGHTS** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I Introduction to Human Rights **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II Evolution and Laws of Human Rights **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III Theories and perspectives UN Laws and Agencies **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV Human Rights in India **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V Human Rights Various Commissions **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

Total: 45 Hours

COURSE OUTCOMES:

After successful completion of the Human Rights course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand basics of Human Rights	**K2**
CO2	Understand the Evolution and Laws of Human Rights	**K2**
CO3	Summarize the various theories and perspectives UN Laws and Agencies	**K2**
CO4	Understand the Human Rights in India	**K2**
CO5	Understand the Human Rights of Various Commissions in India	**K2**

REFERENCE BOOKS:

1. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
2. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME53	Semester	

Subject Name	HUMAN RIGHTS											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	2	-	2	-	2	3	3	3	3
CO2	-	-	2	2	-	2	2	2	1	1	1	1
CO3	-	-	2	2	-	2	-	2	3	3	3	3
CO4	-	-	2	2	-	2	-	2	3	3	3	3
CO5	-	-	3	3	-	3	1	3	2	2	2	2
Average	-	-	2.2	2.2	-	2.2	1.5	2.2	2.4	2.4	2.4	2.4

PSOs matrices of courses selected

Subject Code	18GBME53	Semester	
Subject Name	HUMAN RIGHTS		
CO	PSO1	PSO2	
CO1	2	1	
CO2	2	3	
CO3	3	2	
CO4	2	1	
CO5	2	3	
Average	2.2	2	

PROFESSIONAL ETHICS IN ENGINEERING **L T P C**

18GBME61

3 0 0 3

COURSE OBJECTIVES:

- To enable the students 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 HUMAN VALUES 9

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 II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV 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.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the professional ethics in engineering course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Identify the multiple ethical interests at stake in a real-world situation or in practice.	**K4**
CO2	Understand the variety of moral issues related to engineering ethics.	**K2**
CO3	Identify the ethical concerns in research and intellectual contexts, including academic integrity.	**K4**
CO4	Analyze the risk Benefit Analysis and Reducing Risk in the work environment.	**K6**
CO5	Understand the internships, fieldwork nature and safety responsibilities with rights.	**K2**

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.
4. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME61**			Semester							
Subject Name	**PROFESSIONAL ETHICS IN ENGINEERING**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	2	2	-	2	-	2	3	3	3	3
CO2	-	-	2	2	-	2	2	2	1	1	1	1
CO3	-	-	2	2	-	2	-	2	3	3	3	3
CO4	-	-	2	2	-	2	-	2	3	3	3	3
CO5	-	-	3	3	-	3	1	3	2	2	2	2
Average	-	-	2.2	2.2	-	2.2	1.5	2.2	2.4	2.4	2.4	2.4

PSOs matrices of courses selected

Subject Code	**18GBME61**	Semester	
Subject Name	**PROFESSIONAL ETHICS IN ENGINEERING**		
CO	**PSO1**	**PSO2**	
CO1	2	1	
CO2	2	3	
CO3	3	2	
CO4	2	1	
CO5	2	3	
Average	2.2	2	

18GBME62 QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C

3 0 0 3

COURSE OBJECTIVE:

- To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

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 studiesσvariables – 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-conforming – 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

COURSE OUTCOMES:

After successful completion of the Quality Control and Reliability Engineering course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the concepts of Quality Control and Statistical Process Control variables (SPC).	**K6**
CO2	Understand the Control Charts for Variables and Central Limit Theorem.	**K4**
CO3	Understand the Natural and assignable causes of variation and process control for attributes	**K6**
CO4	Draw and explain the Mean Chart Limits (x-Charts) and Setting the Range Chart Limits (R-Charts)	**K6**
CO5	Understand the Mean and Range Charts and acceptance sampling.	**K5**

TEXT BOOKS:

1. Douglas. C. Montgomery, "Introduction to Statistical quality control", John wiley, 4th edition 2001.
2. Srinath L. S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

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. Gupta R. C., "Statistical Quality control", Khanna Publishers, 1997.
5. Besterfield D.H., "Quality Control", Prentice Hall, 1993.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME62**			Semester							
Subject Name	**QUALITY CONTROL AND RELIABILITY ENGINEERING**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	0	1	2	1	1	2	-	-	-	-	-	3
CO2	2	3	2	2	2	2	-	-	-	-	-	1
CO3	3	2	2	2	2	2	-	-	-	-	-	3
CO4	2	2	2	2	2	3	-	-	-	-	-	3
CO5	2	2	2	2	2	3	-	-	-	-	-	2
Average	1.8	2	2	1.8	1.4	2.4	-	-	-	-	-	2.4

PSOs matrices of courses selected

Subject Code	**18GBME62**	Semester	
Subject Name	**QUALITY CONTROL AND RELIABILITY ENGINEERING**		
CO	**PSO1**	**PSO2**	
CO1	2	3	
CO2	2	2	
CO3	3	1	
CO4	2	3	
CO5	1	2	
Average	2	2.2	

18GBME63	**VALUE ANALYSIS AND VALUE ENGINEERING**	**L**	**T**	**P**	**C**
		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 – godson 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

COURSE OUTCOMES:

After successful completion of the Value Analysis and Value Engineering course, the student will be able to

CO	Course Outcome Statements	Knowledge Level
CO1	Solve complex engineering tasks based on technical-economic disciplines.	K6
CO2	Calculation of costs and evaluation of worth in Value Engineering Methodology.	K4
CO3	Understand the general techniques of brainstorming and ABC analysis.	K6
CO4	Understand functionality important for the customer will improve the worth of the Product and eliminate the unwanted functionality to reducing the overall cost.	K6
CO5	Apply Value Engineering and Value Analysis in the manufacturing products.	K5

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.

REFERENCES:

1. Larry W Zimmesman. P E , "VE –A Practical Approach for Owners Designers and Contractors", CBS Publishers, New Delhi, 1992.
2. Arthus E Mudge, "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.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME63				Semester							
Subject Name	VALUE ANALYSIS AND VALUE ENGINEERING											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	0	0	1	0	2	-	-	-	0	0
CO2	2	1	0	0	1	0	2	-	-	-	0	0
CO3	2	3	2	2	2	2	2	-	-	-	1	1
CO4	0	1	2	2	1	2	0	-	-	-	3	3
CO5	2	3	2	2	2	2	2	-	-	-	1	1
Average	2	1.8	2	2	1.4	2	2	-	-	-	2	2

PSOs matrices of courses selected

Subject Code	18GBME63	Semester	
Subject Name	VALUE ANALYSIS AND VALUE ENGINEERING		
CO	PSO1	PSO2	
CO1	3	2	
CO2	2	2	
CO3	2	2	
CO4	3	3	
CO5	3	2	
Average	2.6	2.2	

18GBME71 **TOTAL QUALITY MANAGEMENT** **L T P C**

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

COURSE OUTCOMES:

After successful completion of the Total Quality Management course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Develop an understanding on quality management philosophies and frameworks.	**K6**
CO2	Adopt TQM methodologies for continuous improvement of quality.	**K6**
CO3	Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement.	**K5**
CO4	Apply benchmarking and business process reengineering to improve management processes.	**K3**
CO5	Determine the set of indicators to evaluate performance excellence of an organization.	**K5**

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. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd.
5. R. Pugazhenthi, A. Baradeswaran, K. Balachandran, and P. Balamurali, "Total Quality Management", sams publications, 2015.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME71**				Semester							
Subject Name	**Total Quality Management**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	2	2	-	2	3	3	3	3
CO2	-	1	-	-	2	2	-	2	3	3	3	3
CO3	-	2	-	-	3	3	-	3	2	2	2	2
CO4	-	2	-	-	2	1	-	1	-	-	-	-
CO5	-	2	-	-	3	3	-	3	2	2	2	2
Average	-	1.6	-	-	2.4	2.2		2.2	2.5	2.5	2.5	2.5

PSOs matrices of courses selected

Subject Code	**18GBME71**	Semester	
Subject Name	**Total Quality Management**		
CO	**PSO1**	**PSO2**	
CO1	1	2	
CO2	2	3	
CO3	1	3	
CO4	2	3	
CO5	1	1	
Average	1.4	2.4	

18GBME72 **Production Planning and Control** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

COURSE OUTCOMES:

After successful completion of the Production Planning and Control course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Develop manufacturing logic and knowledge with help of production planning process.	**K2**
CO2	Understand the concept of work study and ergonomics.	**K3**

CO3	Able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.	**K4**
CO4	Estimate data requirements and sources, Collection of cost, Allowances in production.	**K6**
CO5	Able to plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).	**K5**

TEXT BOOKS:

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Mart and Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007.
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984.
8. Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME72**			Semester							
Subject Name	**Production Planning and Control**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	1	-	-	-	-	-	-	-
CO2	3	2	1	1	2	1	-	-	-	-	-	-
CO3	2	3	2	2	3	2	-	-	-	-	1	1
CO4	-	1	2	2	2	2	-	-	-	-	3	3
CO5	1	2	3	3	3	3	-	-	-	-	2	2
Average	2	1.8	2	2	2.2	2	-	-	-	-	2	2

PSOs matrices of courses selected

Subject Code	**18GBME72**	Semester	
Subject Name	**Production Planning and Control**		
CO	**PSO1**	**PSO2**	
CO1	2	2	

CO2	2	3
CO3	3	2
CO4	2	2
CO5	2	1
Average	2.2	2

18GBME72 ENERGY AUDIT AND ENERGY CONSERVATION METHODS

L	**T**	**P**	**C**
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 - green house effect, global warming -Renewable energy sources - environmental aspects utilization - energy prizes - 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 scheme

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

COURSE OUTCOMES:

After successful completion of the Energy Audit and Energy Conservation Methods course, the student will be able to

CO	Course Outcome Statements	Knowledge Level
CO1:	Understanding the basics of demand side management and mechanisms (technical, legal or financial) that influences energy consumption. Recognizing opportunities for increasing rational use of energy.	K6
CO2:	Understanding the basics of energy auditing with application on different sectors.	K6
CO3:	Understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies	K5
CO4:	Acquired the skills needed for the energy monitoring, auditing and management.	K3
CO5:	Capable of design and analysis of energy conversion systems.	K5

TEXT BOOKS:

1. MurphyW.R. and McKAYG.,"Energy Management, Butterworths, London, 1982.
2. Trivedi P.R., Julka B.R., "Energy Management", Common wealth publishers, 1997.

REFERENCES:

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. Ikken P.A. Swart R.J and Zwerves.S, “Climate and Energy ", 1989.
4. Ray D.A. “Industrial Energy Conservation ", Pergamaon Press, 1980.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME72				Semester							
Subject Name	ENERGY AUDIT AND ENERGY CONSERVATION METHODS											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	0	0	1	0	2	-	-	-	-	0
CO2	2	1	0	0	1	0	2	-	-	-	-	0
CO3	2	1	0	0	1	0	2	-	-	-	-	0
CO4	1	2	3	3	2	3	1	-	-	-	-	2
CO5	0	1	2	2	1	2	0	-	-	-	-	3
Average	1.75	1.2	2.5	2.5	1.2	2.5	1.75	-	-	-	-	2.5

PSOs matrices of courses selected

Subject Code	18GBME72	Semester	
Subject Name	ENERGY AUDIT AND ENERGY CONSERVATION METHODS		
CO	PSO1	PSO2	
CO1	2	2	
CO2	2	2	
CO3	3	1	
CO4	3	1	
CO5	3	1	
Average	2.6	1.4	

18GBME61 QUALITY CONTROL AND RELIABILITY ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVE:

- To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

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 studiesσvariables – 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 conforming – 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

COURSE OUTCOMES:

After successful completion of the Quality Control and Reliability Engineering course, the student will be able to

CO	Course Outcome Statements	Knowledge Level
CO1:	Understand the concepts of Quality Control and Statistical Process Control variables (SPC).	K6
CO2:	Understand the Control Charts for Variables and Central Limit Theorem.	K4
CO3:	Understand the Natural and assignable causes of variation and process control for attributes	K6
CO4:	Draw and explain the Mean Chart Limits (x-Charts) and Setting the Range Chart Limits (R-Charts)	K6

CO5: Understand the Mean and Range Charts and acceptance sampling. K5

TEXT BOOKS:

1. Douglas.C.Montgomery, "Introduction to Statistical quality control", John wiley, 4th edition2001.
2. SrinathL.S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES:

1. John.S.Oakland. Statistical process control", Elsevier, 5th edition, 2005
2. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996.
3. MonoharMahajan, "Statistical Quality Control", DhanpatRai& Sons, 2001.
4. GuptaR.C., "Statistical Quality control", Khanna Publishers, 1997.
5. Besterfield D.H., "Quality Control", Prentice Hall, 1993.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	18GBME61			Semester							
Subject Name	QUALITY CONTROL AND RELIABILITY ENGINEERING										
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	0	1	2	1	1	2	-	-	-	-	-	3
CO2	2	3	2	2	2	2	-	-	-	-	-	1
CO3	3	2	2	2	2	2	-	-	-	-	-	3
CO4	2	2	2	2	2	3	-	-	-	-	-	3
CO5	2	2	2	2	2	3	-	-	-	-	-	2
Average	1.8	2	2	1.8	1.4	2.4	-	-	-	-	-	2.4

PSOs matrices of courses selected

Subject Code	18GBME61	Semester	
Subject Name	QUALITY CONTROL AND RELIABILITY ENGINEERING		
CO	PSO1	PSO2	
CO1	2	3	
CO2	2	2	
CO3	3	1	
CO4	2	3	
CO5	1	2	
Average	2	2.2	

18GBME81 PROCESS PLANNING AND COST ESTIMATION L T P C

3 0 0 3

COURSE OBJECTIVE:

- To introduce the process planning concepts to make cost estimation for various products after process planning.

UNIT I WORK STUDY AND ERGONOMICS 9

Method study – Definition – COURSE OBJECTIVE – Motion economy – Principles – Tools and techniques – Applications – Work measurements – Purpose – Uses – Procedure – Tools and techniques – Standard time – Ergonomics – Principles – Applications.

UNIT II PROCESS PLANNING 9

Definition – Objective – Scope – Approaches to process planning – Process planning activities – Finished part requirements – Operating sequences – Machine selection – Material selection parameters – Se t of documents for process planning – Developing manufacturing logic and knowledge – Production time calculation – Selection of cost optimal processes.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Objective of cost estimation – Costing – Cost accounting – Classification of cost – Elements of cost – Simple problems.

UNIT IV COST ESTIMATION 9

Types of estimates – Methods of estimates – Data requirements and sources – Collection of cost – Allowances in estimation.

UNIT V PRODUCTION COST ESTIMATION 9

Estimation of material cost, labour cost and over heads – Allocation of overheads – Estimation for different types of jobs manufactured by casting – Forging – Welding and machining.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Process Planning and Cost Estimation course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the concept of work study and ergonomics.	**K2**
CO2	Develop manufacturing logic and knowledge with help of production planning process.	**K3**
CO3	Analyze the various type of cost estimating process.	**K4**
CO4	Estimate data requirements and sources, Collection of cost, Allowances in production.	**K6**
CO5	Determine the machining time for various operation in various machines in production Shops.	**K5**

TEXT BOOKS:

1. Sinha, B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.
2. Ostwalal, P.F. and JairoMunez, "Manufacturing Processes and Systems", 9th Edition, JohnWiley,1998.

REFERENCE BOOKS:

1. Russell, R.S. and Tailor, B.W., "Operations Management", 4th Edition, PHI, 2003.

2. Chitale, A.V. and Gupta, R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18CBME72**				Semester							
Subject Name	**Process Planning and Cost Estimation**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	-	-	1	-	-	-	-	-	-	-
CO2	3	2	1	1	2	1	-	-	-	-	-	-
CO3	2	3	2	2	3	2	-	-	-	-	1	1
CO4	-	1	2	2	2	2	-	-	-	-	3	3
CO5	1	2	3	3	3	3	-	-	-	-	2	2
Average	2	1.8	2	2	2.2	2	-	-	-	-	2	2

PSOs matrices of courses selected

Subject Code	**18CBME72**	Semester	
Subject Name	**Process Planning and Cost Estimation**		
CO	**PSO1**	**PSO2**	
CO1	2	2	
CO2	2	3	
CO3	3	2	
CO4	2	2	
CO5	2	1	
Average	2.2	2	

18GBME82 **SUPPLY CHAIN MANAGEMENT** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To make the students familiar with the various concepts and functions of supply chain management, so that the students will be in a position to manage the 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

COURSE OUTCOMES:

After successful completion of the Supply Chain Management course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the logistics and supply chain management	**K2**
CO2	Analyze the design options for Transportation Networks for logistics management.	**K4**
CO3	Develop Framework for network Decisions in managing cycle inventory and safety	**K3**
CO4	Evaluating the Revenue management in supply chain Management	**K5**
CO5	Find the solution for various types of case analysis in supply chain management	**K1**

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.Lucle Press, 2000.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME82**				Semester							
Subject Name	**Supply Chain Management**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	2	1	-	-	-	-	-	-
CO2	-	1	2	2	2	2	-	-	3	-	3	3
CO3	1	2	3	3	3	3	-	-	2	-	2	2
CO4	3	2	1	1	2	1	-	-	-	-	-	-
CO5	2	3	2	2	3	2	-	-	1	-	1	1
Average	2.2	2	1.8	1.8	2.4	1.8	-	-	2	-	2	2

PSOs matrices of courses selected

Subject Code	**18GBME82**	Semester	**VIII**
Subject Name	**Supply Chain Management**		
CO	**PSO1**		**PSO2**
CO1	2		1
CO2	2		2
CO3	1		2
CO4	1		3
CO5	2		1
Average	1.6		1.8

INDUSTRIAL MARKETING AND MARKET RESEARCH L T P C

18GBME83

3 0 0 3

COURSE OBJECTIVE:

- To enable students to deal with newer concepts of marketing concepts like strategic marketing segmentation, pricing, advertisement and strategic formulation. The course will enable a student to take up marketing as a professional career.

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 non-durables to be discussed.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the Industrial Marketing and Market Research course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the industrial and consumer marketing research and to learn about the various industrial products	**K2**
CO2	Analyze the price for industrial products and Evaluate the industrial purchasing decisions	**K4**

CO3	Apply selected research methods and Analyze and interpret both qualitative and quantitative data. Build a simple questionnaire from a web-based survey administration site.	**K3**
CO4	Evaluate appropriate research problem formulation and measurement levels of data	**K5**
CO5	Develop new product strategies & innovations	**K6**

TEXT BOOKS:

1. Ralph S. Alexander, James S. Cross, Richard M. Hill, "Industrial Marketing", Homewood, 1967.
2. Rajendra Nargundkar, "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. Ghosh P K, "Industrial Marketing", Oxford University Press, India.
3. Ramanuj Majumdar, "Marketing Research-Text, Applications and Case Studies".
4. Donald R. Cooper, "Business research Methods", McGraw-Hill, 2005

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME83**				Semester				**VII**			
Subject Name	**Industrial marketing and Market Research**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	1	-	-	-	-	-	-	-
CO2	-	3	2	-	3	-	-	2	1	1	1	1
CO3	-	2	1	-	2	-	-	1	-	-	-	-
CO4	-	2	3	-	3	-	-	3	2	2	2	2
CO5	-	1	2	-	2	-	-	2	3	3	3	3
Average	-	1.8	2	-	2.2	-	-	2	2	2	2	2

PSOs matrices of courses selected

Subject Code	**18GBME83**	Semester	
Subject Name	**Industrial marketing and Market Research**		
CO	**PSO1**	**PSO2**	
CO1	3	2	
CO2	2	2	
CO3	2	1	
CO4	1	2	
CO5	3	3	
Average	2.2	2	

18GBME84 **INTELLECTUAL PROPERTY RIGHTS** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION **9**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs **10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTS AND LEGISLATIONS **10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs **7**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Total: 45 Hours

COURSE OUTCOMES:

After successful completion of the Intellectual Property Rights course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Apply the Intellectual Property portfolio to enhance the value of the firm.	**K2**
CO2	Understand the Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and international.	**K2**
CO3	Understanding various practical aspects of registration of Copy agreements and legislations of intellectual property rights.	**K2**
CO4	Understand and lean the digital products and law intellectual property rights Knowledge.	**K2**
CO5	Understand enforcement of intellectual property rights through the Case Studies.	**K2**

TEXT BOOKS:

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

REFERENCE BOOKS:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.

2. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME84**				Semester							
Subject Name	**INTELLECTUAL PROPERTY RIGHTS**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	2	2	-	2	3	3	3	3
CO2	-	1	-	-	2	2	-	2	3	3	3	3
CO3	-	2	-	-	3	3	-	3	2	2	2	2
CO4	-	2	-	-	2	1	-	1	-	-	-	-
CO5	-	2	-	-	3	3	-	3	2	2	2	2
Average	-	1.6	-	-	2.4	2.2		2.2	2.5	2.5	2.5	2.5

PSOs matrices of courses selected

Subject Code	**18GBME84**	Semester	
Subject Name	**INTELLECTUAL PROPERTY RIGHTS**		
CO	**PSO1**	**PSO2**	
CO1	1	2	
CO2	2	3	
CO3	1	3	
CO4	2	3	
CO5	1	1	
Average	1.4	2.4	

18GBME85 **DISASTER MANAGEMENT** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To provide basic conceptual understanding of disasters and its relationships with development.
- To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To understand Medical and Psycho-Social Response to Disasters.

UNIT I INTRODUCTION TO DISASTER 6

Introduction- Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

UNIT II APPROACHES TO DISASTER RISK REDUCTION 12

Disasters- Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III PRINICPLES OF DISASTER MEDICAL MANAGEMENT 5

Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate-change and urban disasters.

UNIT IV PUBLIC HEALTH RESPONSE AND INTERNATIONAL COOPERATION 15

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNIT V DISASTER RISK MANAGEMENT 7

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental-friendly recovery; reconstruction and development methods.

TOTAL: 45 Hours

COURSE OUTCOMES:

After successful completion of the disaster management course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understanding about the basic concepts of Disaster Management.	**K2**
CO2	Develop the knowledge by providing existing models in risk reduction strategies.	**K3**
CO3	Develop awareness among students in the disaster medicine and make them understand and prepare the natural and manmade disaster.	**K3**
CO4	Understand the health management of disaster is to build capacities that will reduce disaster health risks and contribute to public health.	**K2**

CO5 Create awareness among participants on Disaster Management Scenario. **K6**

TEXT/REFERENCE BOOKS:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority).
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management ,APH Publishing Corporation.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME85**			Semester							
Subject Name	**DISASTER MANAGEMENT**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	-	-	2	2	-	2	3	3	3	3
CO2	-	1	-	-	2	2	-	2	3	3	3	3
CO3	-	2	-	-	3	3	-	3	2	2	2	2
CO4	-	2	-	-	2	1	-	1	-	-	-	-
CO5	-	2	-	-	3	3	-	3	2	2	2	2
Average	-	1.6	-	-	2.4	2.2		2.2	2.5	2.5	2.5	2.5

PSOs matrices of courses selected

Subject Code	**18GBME85**	Semester	
Subject Name	**DISASTER MANAGEMENT**		
CO	**PSO1**	**PSO2**	
CO1	1	2	
CO2	2	3	
CO3	1	3	
CO4	2	3	
CO5	1	1	
Average	1.4	2.4	

18GBME86 **ENGINEERING ECONOMICS** **L T P C**

3 0 0 3

COURSE OBJECTIVE:

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT III CASH FLOW 9

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TOTAL : 45 Hours

COURSE OUTCOMES:

After successful completion of the Engineering Economics course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.	**K2**
CO2	Identify the worthiness of the product by Make or buy decision and know the value of the time value of money.	**K3**
CO3	Understand the cash flow of the industrial system by various methods.	**K2**
CO4	Analyze the capital recovery with return and concept of challenger and defender replacement with maintenance analysis.	**K4**

CO5	Identify the depreciation of the components of the industrial system by Straight line, declining balance, Sum of the year's digits and sinking fund methods.	**K3**

TEXT BOOKS:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME86**			Semester							
Subject Name	**ENGINEERING ECONOMICS**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	1	-	2	-	-	-	-	-
CO2	-	-	2	2	3	2	2	2	1	1	1	1
CO3	-	-	2	2	2	2	-	2	3	3	3	3
CO4	-	-	-	-	1	-	2	-	-	-	-	-
CO5	-	-	1	1	2	1	3	1	-	-	-	-
Average	-	-	1.6	1.6	1.8	1.6	2.2	1.6	2	2	2	**2**

PSOs matrices of courses selected

Subject Code	**18GBME86**	Semester	
Subject Name	**ENGINEERING ECONOMICS**		
CO	**PSO1**	**PSO2**	
CO1	3	3	
CO2	3	3	
CO3	2	3	
CO4	3	3	
CO5	2	3	
Average	3	3	

18GBME87	**ENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
		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 Intra preneur 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

COURSE OUTCOMES:

After successful completion of the Entrepreneurship Development course, the student will be able to

CO	COURSE OUTCOME STATEMENTS	KNOWLEDGE LEVEL
CO1	Understand the basic concepts of entrepreneurship and its application in the recognition of product/ service/ process opportunities	**K2**
CO2	Analyze the issues associated with securing and managing financial resources in new and established organizations.	**K4**
CO3	Develop the distinct entrepreneurial, assess opportunities and constraints for new business ideas	**K6**
CO4	Understanding of new knowledge or new technology with her/his insights for the business.	**K2**
CO5	Identifying opportunities and challenges affiliated with the organization and financing of new initiatives such as new business ventures.	**K3**

TEXT BOOKS:

1. Khanka. S.S., “Entrepreneurial Development” S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning, 2014.

REFERENCE BOOKS:

1. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.

Mapping of Program outcome with course outcome based on attainment levels

Subject Code	**18GBME88**				Semester							
Subject Name	**Entrepreneurship Development**											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	1	-	2	-	-	-	-	-
CO2	-	-	2	2	3	2	2	2	1	1	1	1
CO3	-	-	2	2	2	2	-	2	3	3	3	3
CO4	-	-	-	-	1	-	2	-	-	-	-	-
CO5	-	-	1	1	2	1	3	1	-	-	-	-
Average	-	-	1.6	1.6	1.8	1.6	2.2	1.6	2	2	2	**2**

PSOs matrices of courses selected

Subject Code	**18GBME88**	Semester	
Subject Name	**Entrepreneurship Development**		
CO	**PSO1**	**PSO2**	
CO1	3	3	
CO2	3	3	
CO3	2	3	
CO4	3	3	
CO5	2	3	
Average	3	3	

SYLLABUS

HUMANITIES AND SOCIAL SCIENCES COURSES

15SUPD31	PERSONALITY DEVELOPMENT I	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE: :(Skill Development)

- To improve the interpersonal skills, soft skills, effective team player and analyze strength and weakness to meet their professional career.

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 – Strengths – 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 Hours

COURSE OUTCOMES:

After successful completion of the Personality Development I course, the student will be able to

- **CO1:** Learning the features of Personality; dimensions of personality and components of self concept.
- **CO2:** Developing the soft skills and self appearance.
- **CO3:** Develop the stability and Maturity.
- **CO4:** Developing self-motivation, raised aspirations and belief in one's own abilities.
- **CO5:** Develop the self motivation and emotion at work.

REFERENCES:

1. Personality Development And Soft Skills---Barun K Mitra, Oxford Publication.
2. Seven habits of Higly Effective people – Stephen R. covey.
3. Emotion, motivation and Self regulation - Nathan C. Hall , McGill University, Canada, Thomas Goetz, University of Konstanz, Germany.
4. http://www.emeraldgrouppublishing.com
5. Psychology of Selfesteem – Nathaniel Branden, Nash (1st edition), Jossey-Bass (32nd anniversary edition.

15SUPD41	PERSONALITY DEVELOPMENT II	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE: :(Skill Development)

- To improve the leadership quality, team management, quantitative analyzing knowledge, ordering, sequencing and logical thinking knowledge to meet their professional career.

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 Hours

COURSE OUTCOMES:

After successful completion of the Personality Development II course, the student will be able to

- **CO1:** Develop the character of etiquette in profession.
- **CO2:** Understand the concepts of time management and accounts.
- **CO3:** Develop the Quantitative aptitude.
- **CO4:** Understand the concepts of management.
- **CO5:** Develop the Logical skills.

REFERENCE BOOKS:

1. Personality Enrichment--K R Dhanalakshmi And N S Raghunathan, Margham Publications
2. Personality Development --Dr V M Selvaraj Bhavani Publications
3. Quantitative Aptitude – R. S Aggarwal
4. Logical and Analytical Reasoning (English) 30th Edition – A.K Gupta

15SUPD51	PERSONALITY DEVELOPMENT III	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE: :(Skill Development)

- To improve the verbal aptitude, Speech Mechanism, Sentence Stress knowledge, Personality factors, time management and team building to meet their professional career.

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- summarising phrases—Synonyms—Antonyms—Analogies—Similar Words.

UNIT III SOFT SKILLS IV **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 Hours

COURSE OUTCOMES:

After successful completion of the Personality Development III course, the student will be able to

CO1: Develop the spoken English skills.

CO2: Develops the grammatical skill in English.

CO3: Develop the personality of an Individual.

CO4: Understanding the importance of time management.

CO5: Learning to connect and work with others to achieve a set task.

REFERENCES BOOKS:

1. Managing Soft Skills And Personality - B N Ghosh, Mcgraw Hill Publications.
2. Principles and Practices of Management - Shejwalkar and Ghanekar McGraw Hill Latest.
3. Time management for Busy people – Roberta roesch, Tata Mcgraw-Hill Edition.
4. Personality Development -Dr V M Selvaraj, Bhavani Publications.

15SUPD61	PERSONALITY DEVELOPMENT IV	L	T	P	C

2 0 0 2

COURSE OBJECTIVE: :(Skill Development)

- To improve the communication by understanding the elements of communication, presentation skills, understanding the audience, Personality factors, improve the skill in seminars and conferences presentation.

UNIT I SOFT SKILLS V **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 I **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 Hours

COURSE OUTCOMES:

After successful completion of the Personality Development IV course, the student will be able to

CO1: Development of assertive communication.

CO2: Improve the key elements of Communication skills.

CO3: Understand the key elements of presentation.

CO4: Develop the skill on presentation through PPTs.

CO5: Understand the principles of management.

REFERENCE BOOKS:

1. Helping employees embrace change - LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.
2. Who Moved My Cheese by Spencer Johnson published by Vermilion first edition
3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.
4. Business Communication Today: Bovee, Courtland L, John V. Thill & Barbara E. Schatzman.Tenth Edition. New Jersey: Prentice Hall, 2010.
5.

1 0 1 2

COURSE OBJECTIVE: :(Skill Development)

- To develop character of volunteerism with understanding the youth issues, challenges and opportunities.
- To learn about the community mobilization.

UNIT I INTRODUCTION AND BASIC CONCEPTS OF NSS **6**

NSS: History, philosophy, aims, objectives –Emblem: flag, motto, song, badge- NSS functionaries: Organizational structure, roles and responsibilities.

UNIT II NSS PROGRAMS AND ACTIVITIES **6**

Concept of regular activities- special camping-day camps-Basis of adoption of village/slums, Methodology of conducting survey-Financial pattern of the scheme- other youth program/schemes of GOI- Coordination with different agencies- Maintenance of the dairy.

UNIT III UNDERSTANDING YOUTH **6**

Youth: Definition, profile of youth, categories – youth: Issues, challenges and opportunities - Youth as an agent of social change.

UNIT IV COMMUNITY MOBILIZATION **6**

Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth adult partnership.

UNIT V VOLUNTEERISM AND SHRAMDAN **6**

Indian Tradition of volunteerism-Needs& Importance of volunteerism- Motivation and constraints of volunteerism-Shramdan as a part of volunteerism.

TOTAL: 30 Hours

COURSE OUTCOMES:

After successful completion of the Personality NSS I course, the student will be able to

CO1: Understand the basic concepts of NSS.

CO2: Learn about the NSS Programs and activities.

CO3: Understand the youth issues, challenges and opportunities.

CO4: Learn about the community mobilization.

CO5: Develop character of volunteerism.