	K.S.R. COLLEGE OF ENGINEERING (Autonomous) (Approved by AICTE & Affiliated to Anna University) K.S.R. Kalvi Nagar, Tiruchengode - 637 215	CURRICULUM UG R - 2018
Department	Department of Automobile Engineering	
Programme	B.E – Automobile Engineering	

Vision of the Institution

IV	We envision to achieve status as an excellent Educational Institution in the global knowledge hub, making self-learners, experts, ethical and responsible engineers, technologists, scientists, managers, administrators and entrepreneurs who will significantly contribute to research and environment friendly sustainable growth of the nation and the world.

Mission of the Institution

IM 1	To inculcate in the students self-learning abilities that enable them to become competitive and considerate engineers, technologists, scientists, managers, administrators and entrepreneurs by diligently imparting the best of education, nurturing environmental and social needs.
IM 2	To foster and maintain mutually beneficial partnership with global industries and Institutions through knowledge sharing, collaborative research and innovation.

Vision of the Department / Programme: (Automobile Engineering)

DV	To build long tradition of excellence to be the leading Automobile Engineering program in partnership with our students, alumni, industry and government. The department shall provide the students with educational experiences that will enable them to become leaders in their profession and society. The department shall also maintain and develop world-class research programs that complement our educational mission, address the evolving needs of industry and society, and contribute to economic and social development in the State of Tamil Nadu, across the nation, and around the world.

Mission of the Department / Programme: (Automobile Engineering)

DM 1	To serve students, industry and society by fulfilling the missions of discovery, learning, and engagement through the creation and dissemination.
DM 2	To apply Engineering methods, knowledge, and professional standards relevant to the practice of Automobile Engineering in the many aspects of modern life where it plays a crucial role.

Programme Educational Objectives (PEOs): (Automobile Engineering)

The graduates of the programme will be able to	
PEO 1	**Employability and Higher Studies:** Graduates are knowledgeable in the areas of Automobile industries and successful in their professional career.
PEO 2	**Sustainable Engineering Solutions to the Society:** Graduates continue significant work in their chosen career, and demonstrate social and ethical responsibility.
PEO 3	**Interpersonal and Ethical Proficiency:** Graduates perform both independently and as a member of a team in project management.

Programme Outcomes (POs) of B.E. - Automobile Engineering

Program Outcomes (POs)	
PO1	**Engineering Graduates will be able to:** **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes (PSOs)	
PSO1	**Proficiency Core:** Apply the concepts of electro-mechanical systems, analyse the various automobile components and use design tools specific to automobile industry.
PSO2	**Problem Troubleshooting Skills:** Diagnose the automotive system failures and repair / replace the components / systems.

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SEMESTER - I

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18EN151	Technical English – I (Common To All Branches)	HSMC	2	0	1	3	30	70	100
2.	18MA151	Engineering Mathematics – I (Common To All Branches)	BSC	3	1	0	4	30	70	100
3.	18PH144	Applied Physics (Common To AU & ME)	BSC	3	0	0	3	30	70	100
4.	18ME144	Engineering Drawing (Common To AU & ME)	ESC	1	2	0	3	30	70	100
MANDATORY COURSES										
5.	18MC052	Environmental Science and Engineering (Common To All Branches)	MC	3	0	0	0	50	50	100
PRACTICAL										
6.	18PH028	Physics Laboratory (Common To All Branches)	BSC	0	0	3	1	50	50	100
7.	18AU026	Computer Aided Drawing Laboratory (Common To AU & ME)	ESC	0	0	3	1	50	50	100
Total				**12**	**3**	**7**	**15**	**700**		

*Induction program will be conducted for three weeks as per AICTE guidelines

SEMESTER - II

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18EN251	Technical English – II (Common To All Branches)	HSMC	2	0	1	3	30	70	100
2.	18MA241	Engineering Mathematics – II (Common To AU,CE & ME)	BSC	3	1	0	4	30	70	100
3.	18CH051	Engineering Chemistry (Common To All Branches)	BSC	3	0	0	3	30	70	100
4.	18AU214	Fundamentals of Engineering Mechanics	ESC	3	1	0	4	30	70	100
5.	18CS041	Programming for Problem Solving (Common To AU,CE,EC,EE & ME)	ESC	3	0	0	3	30	70	100
MANDATORY COURSES										
6.	18MC051	Constitution of India (Common To All Branches)	MC	3	0	0	0	50	50	100
PRACTICAL										
7.	18CH028	Chemistry Laboratory (Common To All Branches)	BSC	0	0	3	1	50	50	100
8.	18CS027	Programming for Problem Solving Laboratory (Common To AU,CE,EC,EE & ME)	ESC	0	0	3	1	50	50	100
9.	18GE027	Workshop Practices Laboratory (Common To AU,CE & ME)	ESC	0	0	3	1	50	50	100
Total				**17**	**2**	**10**	**20**	**900**		

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SEMESTER - III

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18MA341	Statistics and Numerical Methods (Common To AU & ME)	BSC	3	1	0	4	30	70	100
2.	18EE041	Basics of Electrical and Electronics Engineering (Common To AU,CE,CS,IT & ME)	ESC	3	0	0	3	30	70	100
3.	18AU313	Mechanics of Materials	PC	3	1	0	4	30	70	100
4.	18AU314	Fluid Mechanics and Hydraulic Machines	PC	3	0	0	3	30	70	100
5.	18AU315	Automotive Manufacturing Technology	PC	3	0	0	3	30	70	100
6.	18AU316	Automotive Chassis	PC	3	0	0	3	30	70	100
PRACTICAL										
7.	18AU321	Fluid Mechanics and Hydraulic Machines Laboratory	PC	0	0	3	1	50	50	100
8.	18AU322	Manufacturing Technology Laboratory	PC	0	0	3	1	50	50	100
9.	18AU323	Mechanics of Materials Laboratory	PC	0	0	3	1	50	50	100
10.	18HR351	Career Development Skills – I (Common To All Branches)	EEC	0	2	0	0	50	50	100
Total				**18**	**4**	**9**	**23**	**1000**		

SEMESTER - IV

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18AU411	Engineering Thermodynamics and Heat Transfer	PC	3	1	0	4	30	70	100
2.	18AU412	Automotive Engines	PC	3	0	0	3	30	70	100
3.	18AU413	Material Science and Metallurgy	PC	3	0	0	3	30	70	100
4.	18AU414	Mechanics of Machines	PC	3	1	0	4	30	70	100
5.	18AU415	Automotive Electrical and Electronics Systems	PC	3	0	0	3	30	70	100
6.	18AU416	Automotive Fuels and Lubricants	PC	3	0	0	3	30	70	100
PRACTICAL										
7.	18AU421	Automotive Fuels and Lubricants Laboratory	PC	0	0	3	1	50	50	100
8.	18AU422	Automotive Electrical and Electronics Systems Laboratory	PC	0	0	3	1	50	50	100
9.	18AU423	Automotive Chassis and Engine Components Laboratory	PC	0	0	3	1	50	50	100
10.	18HR412	Career Development Skills – II	EEC	0	2	0	0	50	50	100
			Total	**18**	**4**	**9**	**23**	**1000**		

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SEMESTER - V

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18AU511	Automotive Transmission	PC	3	0	0	3	30	70	100
2.	18AU512	Design of Machine Elements	PC	3	1	0	4	30	70	100
3.	18AU513	Vehicle Design and Data Characteristics	PC	3	0	0	3	30	70	100
4.	18AU514	Automotive Computer Controlled Systems	PC	3	0	0	3	30	70	100
5.		Open Elective – I	OEC	3	0	0	3	30	70	100
MANDATORY COURSES										
6.	18MC053	Essence of Indian Traditional Knowledge	MC	3	0	0	0	50	50	100
PRACTICAL										
7.	18AU521	Automotive Components Design and Modeling Laboratory	PC	0	0	3	1	50	50	100
8.	18AU522	Automotive Electronics and Microprocessor Laboratory	PC	0	0	3	1	50	50	100
9.	18AU523	Engine Performance and Emission Testing Laboratory	PC	0	0	3	1	50	50	100
10.	18HR513	Career Development Skills – III	EEC	0	2	0	0	50	50	100
			Total	**18**	**3**	**9**	**19**	**1000**		

SEMESTER - VI

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18AU611	Automotive Chassis Components Design	PC	3	1	0	4	30	70	100
2.	18AU612	Automotive Engine Components Design	PC	3	1	0	4	30	70	100
3.	18AU613	Transport Management	PC	3	0	0	3	30	70	100
4.		Professional Elective – I	PEC	3	0	0	3	30	70	100
5.		Open Elective – II	OEC	3	0	0	3	30	70	100
6.		Open Elective – III	OEC	3	0	0	3	30	70	100
PRACTICAL										
7.	18AU621	Vehicle Components Design and Analysis Laboratory	PC	0	0	3	1	50	50	100
8.	18AU622	Computer Aided Manufacturing Laboratory	PC	0	0	3	1	50	50	100
9.	18AU623	Summer Internship	EEC	0	0	3	1	50	50	100
10.	18HR614	Career Development Skills – IV	EEC	0	2	0	0	50	50	100
		Total		**18**	**4**	**9**	**23**	**1000**		

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SEMESTER - VII

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18HS051	Professional Ethics (Common To All Branches)	HSMC	3	0	0	3	30	70	100
2.	18AU712	Vehicle Dynamics	PC	3	0	0	3	30	70	100
3.	18AU713	Vehicle Maintenance and Testing	PC	3	0	0	3	30	70	100
4.		Professional Elective – II	PEC	3	0	0	3	30	70	100
5.		Professional Elective – III	PEC	3	0	0	3	30	70	100
6.		Open Elective – IV	OEC	3	0	0	3	30	70	100
PRACTICAL										
7.	18AU721	Vehicle Maintenance and Reconditioning Laboratory	PC	0	0	3	1	50	50	100
8.	18AU722	Project – I	EEC	0	0	6	3	50	50	100
			Total	**18**	**0**	**9**	**22**	**800**		

SEMESTER - VIII

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1.	18AU811	Electric and Hybrid Vehicles	PC	3	0	0	3	30	70	100
2.		Professional Elective – IV	PEC	3	0	0	3	30	70	100
3.		Professional Elective – V	PEC	3	0	0	3	30	70	100
PRACTICAL										
4.	18AU821	Project – II	EEC	0	0	12	6	50	50	100
			Total	**9**	**0**	**12**	**15**	**400**		

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List of Electives

PROFESSIONAL ELECTIVE – I (SEMESTER – VI)

Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18AU661	Automotive Air-Conditioning	S1	PEC	3	0	0	3	30	70	100
2.	18AU662	Alternative Fuels and Energy Systems	S1	PEC	3	0	0	3	30	70	100
3.	18AU663	Virtual Instrumentation in Automobile Engineering	S2	PEC	3	0	0	3	30	70	100
4.	18AU664	Vehicle Body Engineering	S2	PEC	3	0	0	3	30	70	100
5.	18AU665	Automotive Aerodynamics	S3	PEC	3	0	0	3	30	70	100
6.	18AU666	Design of Automotive Jigs, Fixtures and Press Tool	S3	PEC	3	0	0	3	30	70	100

PROFESSIONAL ELECTIVE – II (SEMESTER – VII)

Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18AU761	Advanced Theory and Simulation of I.C. Engines	S1	PEC	3	0	0	3	30	70	100
2.	18AU762	Automotive Vehicle Safety	S2	PEC	3	0	0	3	30	70	100
3.	18AU763	Two and Three Wheelers	S2	PEC	3	0	0	3	30	70	100
4.	18AU764	Ergonomics and Aesthetics in Automotive Design	S3	PEC	3	0	0	3	30	70	100
5.	18AU765	Rapid Prototyping Tooling and Manufacturing	S4	PEC	3	0	0	3	30	70	100
6.	18AU766	Manufacturing of Automotive Components	S4	PEC	3	0	0	3	30	70	100

PROFESSIONAL ELECTIVE – III (SEMESTER – VII)

Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18AU767	Combustion Thermodynamics and Heat Transfer	S1	PEC	3	0	0	3	30	70	100
2.	18AU768	Automotive Pollution and Control	S2	PEC	3	0	0	3	30	70	100
3.	18AU769	Intelligent Vehicles Technology	S2	PEC	3	0	0	3	30	70	100
4.	18AU771	Finite Element Analysis	S3	PEC	3	0	0	3	30	70	100
5.	18AU772	Industrial Robotics and Expert Systems	S4	PEC	3	0	0	3	30	70	100
6.	18AU773	Foundation Skills in Integrated Product Development	S5	PEC	3	0	0	3	30	70	100

PROFESSIONAL ELECTIVE – IV (SEMESTER – VIII)											
Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18AU861	Fuel Cells and Applications	S2	PEC	3	0	0	3	30	70	100
2.	18AU862	Special Purpose Vehicles	S2	PEC	3	0	0	3	30	70	100
3.	18AU863	Engineering Optimization	S3	PEC	3	0	0	3	30	70	100
4.	18AU864	Flexible and Lean Manufacturing	S4	PEC	3	0	0	3	30	70	100
5.	18AU865	Entrepreneurship Development	S5	PEC	3	0	0	3	30	70	100
6.	18AU866	Engineering Economics and Finance	S5	PEC	3	0	0	3	30	70	100

PROFESSIONAL ELECTIVE – V (SEMESTER – VIII)											
Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18AU867	Operations Research and Vehicle Routing	S2	PEC	3	0	0	3	30	70	100
2.	18AU868	Noise, Vibration and Harshness	S2	PEC	3	0	0	3	30	70	100
3.	18AU869	Vehicle Dealership Management	S5	PEC	3	0	0	3	30	70	100
4.	18AU871	Reliability in Automobile Engineering	S4	PEC	3	0	0	3	30	70	100
5.	18AU872	Production Planning and Control	S4	PEC	3	0	0	3	30	70	100
6.	18HS002	Total Quality Management (Common To All Branches)	S5	PEC	3	0	0	3	30	70	100

LIST OPEN ELECTIVES (SEMESTER – V to VIII)											
Sl.No.	Course Code	Course Name	Specialization	Category	Hours/ Week			Credit	Maximum Marks		
					L	T	P	C	CA	ES	Total
1.	18CE862	Smart Materials and Smart Structures	CE	OEC	3	0	0	3	30	70	100
2.	18CE867	Municipal Waste and Management	CE	OEC	3	0	0	3	30	70	100
3.	18CE766	Environmental Impact Assessment	CE	OEC	3	0	0	3	30	70	100
4.	18CE865	Housing, Planning and Management	CE	OEC	3	0	0	3	30	70	100
5.	18CS869	Internet of Things	CS	OEC	3	0	0	3	30	70	100
6.	18CS002	Java Programming	CS	OEC	3	0	0	3	30	70	100
7.	18CS711	Big Data and Cloud Computing	CS	OEC	3	0	0	3	30	70	100
8.	18CS613	Software Testing	CS	OEC	3	0	0	3	30	70	100
9.	18CS871	M – Commerce	CS	OEC	3	0	0	3	30	70	100
10.	18EC662	Medical Electronics	EC	OEC	3	0	0	3	30	70	100
11.	18EE099	Electrical Wiring, Estimation and Costing	EE	OEC	3	0	0	3	30	70	100
12.	18EE691	Electrical Drives and Control Systems	EE	OEC	3	0	0	3	30	70	100
13.	18EE868	Electronic Instrumentation	EE	OEC	3	0	0	3	30	70	100
14.	18EE711	Embedded Systems	EE	OEC	3	0	0	3	30	70	100
15.	18IT563	Mobile Computing	IT	OEC	3	0	0	3	30	70	100
16.	18ME777	Hydraulics and Pneumatics	ME	OEC	3	0	0	3	30	70	100
17.	18ME564	Power Plant Engineering	ME	OEC	3	0	0	3	30	70	100
18.	18ME712	Mechatronics	ME	OEC	3	0	0	3	30	70	100
19.	18ME774	Fundamentals of Nano Science	ME	OEC	3	0	0	3	30	70	100
20.	18HS001	Principles of Management	HS	OEC	3	0	0	3	30	70	100

S1 –Thermal Engineering
S2 –Automobile Engineering
S3 –Design
S4 –Manufacturing Engineering
S5 – Management

LIST OF VALUE ADDED COURSES

Sl. No.	Course Name	Number of Hours	Offered by Internal / External
1	Business English Certification	15	Internal / External
2	Other Linguistic Learning like German, Japanese, etc.	15	Internal / External
3	Automotive Styling	15	Internal / External
4	Vehicle Service Management	15	Internal / External
5	Online Course Certification from edX/ Coursera / NPTEL, etc.	15	Internal/ External
6	Accident and Insurance Survey	15	Internal / External
7	Logistic Management	15	Internal / External
8	Electronic Engine Management System	15	Internal / External
9	Navigation and Guidance Systems	15	Internal / External
10	Instrumentation and Control in Automobile Engineering	15	Internal/ External
11	Course on Intellectual Property Rights	15	Internal / External
12	Tractor and Farm Equipment	15	Internal / External

COURSE COMPONENT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credits Total	Percentage Credits
		I	II	III	IV	V	VI	VII	VIII		
1.	**HSMC**	3	3	-	-	-	-	3	-	9	5.62
2.	**BSC**	8	8	4	-	-	-	-	-	20	12.5
3.	**ESC**	4	9	3	-	-	-	-	-	16	10
4.	**PC**	-	-	16	23	16	13	7	3	78	48.75
5.	**PEC**	-	-	-	-	-	3	6	6	15	9.38
6.	**OEC**	-	-	-	-	3	6	3	-	12	7.5
7.	**EEC**	-	-	-	-	-	1	3	6	10	6.25
TOTAL		**15**	**20**	**23**	**23**	**19**	**23**	**22**	**15**	**160**	**100**

Total No. of Credits = 160

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

SEMESTER – I (Common to All Branches)

		L	T	P	C
18EN151	**TECHNICAL ENGLISH - I**	2	0	1	3

Prerequisite: -

Objectives:

- *To develop basic conversation skills.*
- *To build vocabulary skills with the right choice of words.*
- *To improve students' understanding of grammar in context progressively.*
- *To empower students on professional writing*
- *To use the LSRW skills in professional context*

UNIT - I **[9]**

Synonyms & Antonyms – Tenses (Simple Present, Present Continuous, Present Perfect, Simple Past, and Simple Future) – Use of Modal Auxiliaries – Infinitive and Gerund – Intensive Reading – Predicting Content – Interpretation – Active Listening – Listening for the main idea – Need based Correspondence (request for joining hostel, bonafide certificate)

UNIT - II **[9]**

British & American Terminology - Impersonal passive – Standard Abbreviations and Acronyms - Predicting Content - Drawing inferences - Listening for specific details - Listening to News – Job Application and Resume – Writing Instructions

UNIT - III **[9]**

Preposition of Time, Place and Movement – Concord (Subject & Verb Agreement) – Passive Voice – Consonant Sounds – Pronunciation guidelines related to Vowels and Consonant – Skimming & Scanning - Inference – Context Based Meaning - Welcome Speech – Vote of Thanks.

UNIT - IV **[9]**

Newspaper Reading – Vocabulary Building – Phrasal Verbs (Put, Give, Look, Take, Get, Call) – Note making – Rearranging the jumbled sentences - MoC – Anchoring – Role play in academic context – E Mail Etiquette – Introducing others.

UNIT - V **[9]**

Listening to Dialogues – Listening to Telephonic Conversation - Recommendation Writing - Letter of Invitation (inviting, accepting and declining) – Paragraph writing - Letter to the Editor of a News paper – Drills using Minimal pairs – Presentation Skills.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend and apply Grammar in context for professional communication.
CO2: Infer the gist and specific information.
CO3: Ability to speak, express and interact in the society and place of study.
CO4: Critically interpret by reading a text and comprehend a given text.
CO5: Correspond and communicate for jobs.

Text Book :

1 Dr.P. Rathna, English Work Book – I, VRB Publishers Pvt. Ltd., Chennai, Fourth Edition, 2018

2 S.Sumant, Technical English – I, Vijay Nicole, Chennai, Second Edition, 2018

Reference Books :

1 Meenakshi Raman, Technical Communication, Oxford University Press, New Delhi, First Edition, 2017

2 Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, First Edition, 2016

3 M Ashraf Rizvi, Effective Technical Communication, Tata McGRAW HILL, New Delhi, First Edition, 2005.

4 P.Kiranmani Dutt, A course in Communication Skills, Cambridge University Press, New Delhi, First Edition, 2014.

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SEMESTER - I

18MA151	**ENGINEERING MATHEMATICS – I**	L	T	P	C
	(COMMON TO ALL BRANCHES)	3	1	0	4

Prerequisite: *-*

Objectives:

- *To study the concepts of Matrices and its Applications.*
- *To study the concepts and its applications of Ordinary Differential Equations*
- *To acquire knowledge in solving differential calculus.*
- *To study the concepts of functions of several variables*
- *To acquire the basics of Vector Calculus and its applications.*

UNIT - I LINEAR ALGEBRA [12]

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (Excluding proof) – Cayley Hamilton theorem (excluding proof) - Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT - II ORDINARY DIFFERENTIAL EQUATIONS [12]

Linear differential equations of second and higher order with constant coefficients – Differential equations with variable coefficients – Cauchy's and Legendre's linear equations – Method of variation of parameters.

UNIT - III DIFFERENTIAL CALCULUS [12]

Curvature - Radius of curvature (Cartesian co-ordinates only) – Centre of curvature and Circle of curvature – Involutes and Evolutes.

UNIT - IV FUNCTIONS OF SEVERAL VARIABLES [12]

Partial derivatives – Total derivatives – Euler's theorem for homogenous functions – Taylor's series expansion - Maxima and Minima for functions of two variables – Method of Lagrangian multipliers.

UNIT - V VECTOR CALCULUS [12]

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Green's theorem in plane, Gauss divergence theorem and Stoke's theorem – Problems in Cube, Cuboid and Rectangular paralleopiped only.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Interpret the basics of Matrix applications in the field of engineering.
CO2: Acquire knowledge in solving ordinary differential equations.
CO3: Explain and apply the concepts of differential calculus problems.
CO4: Skills in developing and solving the functions of several variables.
CO5: Acquire the basics of vector calculus and its applications

Text Books :

1. Ravish R Singh and Mukul Bhatt, Engineering Mathematics – I, McGraw Hill Publications, Third Edition, New Delhi, 2016.
2. Grewal B.S, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company,, Forty third Edition, New Delhi, 2015.

References :

1. Bali N. P and Manish Goyal, Text book on Engineering Mathematics, Laxmi Publications (p) Ltd., Seventh Edition, 2016.
2. H.K. Dass, Advance Engineering Mathematics, S. Chand and company, Eleventh Edition, 2015.
3. Jain R.K. and Iyengar S.R.K., - Advanced Engineering Mathematics, Narosa Publicaitons, Eighth Edition, 2012.
4. http://www.sosmath.com/matrix/matrix.html

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SEMESTER - I

		L	T	P	C
18PH144	**APPLIED PHYSICS** (Common to AU & ME)	3	0	0	3

Prerequisite: *-*

Objectives:

- *To recognize the various types of crystal structure and its application in the field of Engineering.*
- *To compute and analyze various problems related to Applied Physics.*
- *To understand the basic concepts behind the Crystal Structures and Quantum Physics.*
- *To explore the basic concepts behind Materials & Laser Technology and Ultrasonics.*
- *To comprehend the fundamentals of physics thereby exploring it for potential engineering applications.*

UNIT - I CRYSTAL PHYSICS [9]

Introduction to crystalline and amorphous solids – lattice and unit cell – seven crystal system and Bravais lattices – Miller indices(hkl) –d-spacing in cubic lattice – atomic radius – coordination number – packing factor calculation for sc, bcc, fcc and hcp– Crystal growth techniques – solution, melt (Bridgman and Czochralski).

UNIT - II QUANTUM PHYSICS [9]

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect - Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box.

UNIT - III MATERIALS TECHNOLOGY [9]

Properties of matter: Hooke's Law - Stress -Strain Diagram - Elastic Moduli - Poisson's ratio - Expression for bending moment and depression - Cantilever - Expression for Young's modulus by Non uniform bending and its experimental determination. Materials testing: Mechanism of plastic deformation- slip and twinning – types of fracture –fatigue and creep test - Vickers Hardness test.

UNIT - IV LASER TECHNOLOGY [9]

Introduction – Properties - Einstein's Quantum theory of radiation: A and B coefficients - amplification of light by population inversion –pumping methods - Types of lasers: gas lasers - CO_2, solid state lasers (Nd - YAG) - semiconductor lasers - Applications.

UNIT - V ULTRASONICS [9]

Introduction – properties - Production: Piezoelectric oscillator – Detection of ultrasonic waves – acoustic grating - velocity measurement –Industrial applications –drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - Medical applications – Sonograms.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Utilize the conceived concepts and techniques for synthesizing novel crystals with enhanced multifunctional properties.
CO2: Enumerate the preambles of quantum physics and implement its concepts to tackle the cumbersome engineering problems.
CO3: Comprehend the fundamental ideas of strength of material for designing engineering components.
CO4: Categorize the types of laser and utilize it for specific application based on their desirable requisite.
CO5: Tackle the impact of engineering problem using nondestructive testing and biological applications.

Text Book :

1 M.N. Avadhanulu and P.G. Kshirsagar, "A text book of Engineering Physics", S. Chand and Company, New Delhi, Seventh Edition, 2014.
2 R.K.Gaur&S.L.Gupta, "Engineering Physics", Dhanpat Rai Publication, New Delhi, Seventh Edition, 2014.

Reference Books :

1 D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & sons, USA, Ninth Edition, 2011.
2 V. Rajendran, "Engineering Physics", Tata McGraw Hill, New Delhi, First Edition, 2011.
3 R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", Cengage Learning, USA, Ninth Edition, 2013.
4 Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, New Delhi, Sixth Edition, 2010.

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SEMESTER - I

		L	T	P	C
18ME144	**ENGINEERING DRAWING** (Common to AU & ME)	1	2	0	3

Prerequisite: -

Objectives:

- *To gain the knowledge on plane curves and orthographic projection.*
- *To sketch the projection of points, lines and plane surfaces.*
- *To practice the projection of solids.*
- *To construct the section of solids and development of surfaces.*
- *To be taught the isometric and perspective projections.*

UNIT - I PLANE CURVES AND ORTHOGRAPHIC PROJECTION [09]

Introduction on drafting instruments, BIS conventions and specifications, Lettering and Dimensioning-Conics-Construction of ellipse, parabola and hyperbola by eccentricity method -Construction of cycloid-Construction of involutes-Drawing of tangents and normal to the above curves. Representation of three dimensional objects-General principles of orthographic projection- First angle projection.

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACES [09]

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 any one reference plane.

UNIT - III PROJECTION OF SOLIDS [09]

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

UNIT - IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES [09]

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

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS [09]

Principles of isometric projection - isometric scale -isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.

Total (L : 15 T : 30) = 45 Periods

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

CO1: Gain knowledge on basic drafting convention and perform sketching of basic geometrical constructions and Orthographic projections of Engineering components.
CO2: Draw orthographic projection of points, lines and plane surfaces inclined to principle planes.
CO3: Practicing projections of simple solids which are inclined to reference planes by change of position method.
CO4: Construct sectional views and development of surfaces of simple and truncated solids
CO5: Prepare isometric views of simple solids and perspective projections of solids by visual ray method

Text Books :

1. Natarajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition,2016.
2. Kumar, M.S., Engineering Graphics, D.D. Publications, Chennai, Second Edition, 2007.

Reference Books :

1. Venugopal & Prabhu Raja, V., Engineering Graphics, New Age International (P) Limited, Chennai, Second Edition, 2008.
2. Bhatt, N.D., Engineering Drawing, Charotar Publishing House, Gujarat, Fifty Third Editions, 2014.
3. Shah, B., and Rana, B.C., Engineering Drawing, Pearson Education, Bengalore, Second Edition, 2009.
4. Gopalakrishna, K.R., Engineering Drawing (Vol.I & II), Subhas Publications, Bangalore, Second Edition, 2010.
5. Basant Agarwal and Agarwal C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2013..

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SEMESTER – I

		L	T	P	C
18MC052	**ENVIRONMENTAL SCIENCE AND ENGINEERING (Mandatory, non - credit course) (Common to All Branches)**	3	0	0	0

Prerequisite: *-*

Objectives:

- *To impart knowledge on the principle of environmental science and engineering.*
- *To embellish the students to understand the usages of natural resources, ecosystem and biodiversity.*
- *To create awareness on pollution, value education and social issues.*
- *To appreciate the importance of environment by assessing its impact on the human world.*
- *To envision the surrounding environment, its functions and its value.*

UNIT - I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES [9]

Environment – definition – scope and importance – need for public awareness; Forest resources – use – over exploitation – deforestation; Water resources – over–utilization of surface and ground water; Mineral resources – environmental effects of extracting and using mineral resources; Food resources – overgrazing – effects of modern agriculture – fertilizer–pesticide problems – water logging – salinity; Role of an individual in conservation of natural resources. **Activity:** Slogan making event on conserving natural resources or plantation of trees.

UNIT - II ECOSYSTEM AND BIODIVERSITY [9]

Concept of an ecosystem – structure and function of an ecosystem – producers – consumers and decomposers – Food chain – food web – energy flow in the ecosystem – ecological pyramids – Ecological succession; Forest ecosystem and Aquatic ecosystems (Estuary and marine ecosystem); Biodiversity – introduction – definition – Values of biodiversity; Hot-spots of biodiversity; Endangered and Endemic Species of India. **Activity:** Arrange a trip to visit different varieties of plants.

UNIT - III ENVIRONMENTAL POLLUTION [9]

Pollution – introduction and different types of pollution; Causes – effects and control measures of air pollution and water pollution – water quality parameters – hardness – definition – types; Alkalinity – definition – types; BOD and COD (definition and significance); Noise pollution – solid waste management – hazardous waste – medical and e-wastes; Role of an individual in prevention of pollution. **Activity:** Drive for segregation of waste or cleanliness drive.

UNIT - IV SOCIAL ISSUES AND ENVIRONMENT [9]

Water conservation – rain water harvesting and watershed management; Environmental ethics – Issues and possible solutions; Climate change – global warming and its effects on flora and fauna – acid rain – ozone layer depletion; Disaster Management – earth quake – cyclone – tsunami – disaster preparedness – response and recovery from disaster. **Activity:** Poster making event on water management or Climate change.

UNIT - V SUSTAINABILITY AND GREEN CHEMISTRY [9]

Sustainable development – from unsustainable to sustainable development – Environmental Impact Assessment (EIA); Human rights; Value education; HIV/AIDS; Role of information technology in environment and human health; 12 Principles of Green Chemistry. **Activity:** Group discussion on Sustainability or Lecture from an expert on Green chemistry.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Prioritize the importance in conservation of resources for future generation
CO2: Relate the importance of ecosystem and biodiversity
CO3: Analyze the impact of pollution and hazardous waste in a global and societal context.
CO4: Identify the contemporary issues that result in environmental degradation that would attempt to provide solutions to overcome the problems
CO5: Categorize the concept of Sustainability and Green Chemistry.

Text Book:

1 Dr. T. Arun Luiz, Environmental Science and Engineering, S. Chand & Company Private Limited, New Delhi, First Edition, 2016.

2 Anubha Kaushik and C. P. Kaushik, Environmental Science and Engineering, New Age International Publishers, Chennai, Fourth Edition, 2014.

Reference Books:

1 G. Tyler Miller and Scott E. Spoolman, Environmental Science, Cengage Learning India Private Limited, New Delhi, Fourteenth Edition, 2014.
2 Dr. A. Ravikrishnan, Environmental Science and Engineering, Sri Krishna Hi-tech Publishing Company Private Limited, Chennai, Tenth Edition, 2014.
3 Raman Sivakumar, Introduction to Environmental Science and Engineering, Tata McGraw Hill Education Private Limited, Fourth Edition, 2012.
4 S S. Dara, A Text book of Environmental Chemistry and pollution control, S. Chand & Company Limited, New Delhi, Tenth Edition, 2005.

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SEMESTER – I

		L	T	P	C
18PH028	**PHYSICS LABORATORY** (Common to all branches)	0	0	3	1

Prerequisite: *-*

Objectives:

- *To train engineering students on basis of measurements and the instruments.*
- *To gain the practical knowledge and hands on experiences of understanding the physics concepts applied in optics, sound and thermal physics.*
- *To give practical training on basic Physics experiments which are useful to engineers.*
- *Apply the analytical techniques and graphical analysis to the experimental data.*
- *To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.*

List of Experiments:

1. Determination of wavelength of Laser using grating and the Size of the Particles.
2. Determination of thickness of the given material by Air – wedge method.
3. Determination of velocity of Ultrasonic waves and compressibility using Ultrasonic interferometer.
4. Spectrometer grating - Determination of wavelength of mercury spectrum.
5. Determination of thermal conductivity of a bad conductor by Lee's disc method.
6. Determination of Young's modulus of the material of a uniform bar by Non – Uniform bending method.
7. Determination of Band gap energy of a semiconductor.
8. Determination of Viscosity of a given liquid by Poiseuille's method.
9. Torsional pendulum - Determination of rigidity modulus of a given wire.
10. V-I Characteristics of Solar Cell.

Total : 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the different physical parameters of optics.
CO2: Perceive the production of ultrasonic waves through inverse piezoelectric effect and to determine the velocity of sound waves in the given liquid.
CO3: Explore the principle of thermal conductivity thereby to calculate the thermal conductivity of various bad conductors like cardboard, mica, etc.
CO4: Confer the experimental counterparts of materials properties such as modulus, solar cell, and energy gap.
CO5: Imbibe the concept of capillary action in fluid dynamics and to compare the coefficient of viscosity of the given liquid.

Text Book:

1. Faculty Members of Physics, Physics Lab manual, Department of Physics, K.S.R. College of Engineering, Namakkal Seventeenth Edition, 2018.
2 Dr. P. Mani, Physics Lab Manual & Observation Book, Dhanam Publications, Twelfth Edition Chennai 2017.

Reference Books:

1. Dr.M.Arumugam, "Physics Lab manual", Anuradha Publications, Kumbakonam, (2017).
2. R Suresh & Dr. C. Kalyanasundaram, Physics Laboratory, Sri Krishna Hitech Publishing Company Pvt. Ltd., Chennai, Fifth Edition, 2017.

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SEMESTER - I

		L	T	P	C
18AU026	**COMPUTER AIDED DRAWING LABORATORY** (Common To AU & ME)	0	0	3	1

Prerequisite: *-*

Objectives:

- *To develop skill for using software to create 2D and 3D Models.*
- *To draw two dimensional sketches, views in AutoCAD environment.*
- *To create solid models of objects, objects in basic shapes etc.*
- *To explain and interpret the sectional views of the solid objects.*
- *To create the isometric projections and 3D models of simple objects*

List of Experiments:

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, in volute using B spine or cubic spine.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and dimensioning.
5. Drawing of front view, top view and side view of objects from the given pictorial views (e.g. V block, base of a mixie, simple stool, objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc.
9. Drawing isometric projection of simple objects.
10. Creation of 3D models of simple objects and obtaining 2D multi-view drawings from 3D model.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Demonstrate graphical skills like drafting and modeling using the software packages.
CO2: Draw the engineering curves.
CO3: Create 2D and 3D models of engineering components and residential building.
CO4: Construct the sectional views and isometric projection of the solid objects.
CO5: Create, render, and manipulate 3D AutoCAD drawings and convert 2D drawings to 3D drawings.

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SEMESTER – II (Common to All Branches)

		L	T	P	C
18EN251	**TECHNICAL ENGLISH - II**	2	0	1	3

Prerequisite: *-*

Objectives:

- *To make students firm on vocabulary and grammar.*
- *To develop students speaking ability*
- *To enhance students' professional skills on professional writing.*
- *To enable students reading and listening skills.*
- *To optimize LSRW skills for personal development*

UNIT - I **[9]**

Technical Vocabulary – Changing words from one form to another - Articles – Compound Nouns - Critical reading - Need based Correspondence (In plant training & Industrial Visit) - Context based meaning – Introducing Oneself – Writing short Essays.

UNIT - II **[9]**

Numerical Adjectives – Prefixes & Suffixes - If Conditionals – E-mail Writing - Greetings and Introductions – Making Requests – Seeking Information – Inviting People – Likes & Dislikes -. Listening for main ideas - Report Writing.

UNIT - III **[9]**

Framing Questions – 'Wh' Question – Yes / No Question – Discourse markers - Cause and Effect Expression - Critical reading, Making inference - Transcoding (Interpretation of Charts) - Listening and Note taking – Oral Presentation.

UNIT - IV **[9]**

Expression of Purpose – Editing text for Spelling and Punctuation – Redundancies - Business Correspondence – Calling for Quotations, Seeking Clarification, placing order and Complaint - Extensive Listening – Short Comprehension Passages.

UNIT - V **[9]**

Instructions – Describing – Telephone Etiquette - Listening to fill up forms and gapped texts – Agenda and Minutes of meeting – Check list – Essay Writing – Reading Short texts from Journals and Newspapers.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend and apply the enriched vocabulary, by knowing the basic grammatical structure, in academic and professional contexts.
CO2: Recognize and use Standard English in diverse situations.
CO3: Critically interpret by reading a text and comprehend a given text.
CO4: Compose and write clearly in professional contest.
CO5: Enhance the listening skill for academic purposes.

Text Book :

1 Dr.P.Rathna, English Work Book – II, VRB Publishers Pvt. Ltd., Chennai, Second Edition, 2016

2 S.Sumant, Technical English – I, Vijay Nicole, Chennai, Second Edition, 2018

Reference Books :

1 Dr.S.Sumant,Technical English I, Tata McGraw Hill,Chennai, First Edition, 2016.

2 Dept. of Humanities and social sciences, Anna University, Chennai, English for Engineers and Technologists, Orient Longman, First Edition, 2014.

3 Hory Sankar Mukerjee, Business Communication, Oxford University Press, New Delhi, First Edition, 2013.

4 Department of English, English for Technologists and Engineers, Orient Black Swan, Chennai, First Edition, 2016.

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SEMESTER - II

18MA241	ENGINEERING MATHEMATICS – II (COMMON TO B.E. AU, CE & ME)	L	T	P	C
		3	1	0	4

Prerequisite: -

Objective(s):

- *To study the concepts of analytic functions, conformal mapping and bilinear transformations.*
- *To acquire knowledge in complex integration.*
- *To study the concepts of Fourier series and its applications*
- *To acquire knowledge in partial differential equations and its applications.*
- *To study the concepts of Laplace transform and inverse Laplace transform techniques.*

UNIT - I ANALYTIC FUNCTIONS [12]

Functions of a complex variable – Analytic functions – Necessary and sufficient conditions: Cauchy – Riemann Equation (excluding proof) – Harmonic functions – Construction of analytic functions (Milne Thomson method) – Conformal mapping : w = z+c, cz, 1/z and bilinear transformation.

UNIT - II COMPLEX INTEGRATION [12]

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Laurent's series expansion – Singular points – Residues – Cauchy's residue theorem – Evaluation of real and definite integrals on unit circle and semi – circular contour (excluding poles on boundaries).

UNIT - III FOURIER SERIES [12]

Dirichlet's conditions – General Fourier series - Odd and Even functions – Half range sine and cosine series – Harmonic analysis.

UNIT - IV PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS [12]

Formation of partial differential equations – Lagrange's linear equation - Solutions of one dimensional wave equation – Problems on vibrating string with zero and non - zero initial velocity – One dimensional heat equation – Problems of steady state condition with zero and non- zero boundary values.

UNIT - V LAPLACE TRANSFORMATION [12]

Laplace transforms – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives – Initial and final value theorems (excluding proof). Transform of periodic functions. Inverse Laplace transforms (partial fraction method only) – Solution of linear ordinary differential equations of second order with constant coefficients.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the concepts of analytic functions, conformal mapping and bilinear transformations.
CO2: Solve the problems of Complex Integration.
CO3: Identify the basics of Fourier series and its applications in the field of engineering.
CO4: Analyze the concepts of partial differential equations and its applications.
CO5: Gain the fundamentals of Laplace transform Inverse Laplace transform and its applications.

Text Books:

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics II", McGraw Hill Publications, New Delhi, Third Edition, 2016.
2. Grewal B.S,"Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, Forty third Edition, 2015.

References:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, Seventh Edition. (2016).
2. Bali N.P and Manish Goyal, Engineering Mathematics, Laxmi Pub, Chennai, Seventh Edition, 2016
3. P. Anuradha and V. Sudhakar, "Transforms and Partial Differential Equations", Scitech publication, Chennai, Second Edition, 2014.
4. Ian Sneddon, Elements of Partial Differential Equations, McGraw-Hill International Editions, New Delhi, Thirty fifth Edition, 2012.

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SEMESTER – II

		L	T	P	C
18CH051	**ENGINEERING CHEMISTRY** (Common to All Branches)	3	0	0	3

Prerequisite: *-*

Objectives:

- *To Impart knowledge about the manufacture, properties and uses of advanced engineering materials*
- *To acquaint the students with the basic concepts of corrosion mechanism and its control*
- *To understand the concept of thermodynamics*
- *To gain knowledge about atomic structure and chemical bonding*
- *To make the students conversant with various spectroscopic techniques*

UNIT - I ADVANCED ENGINEERING MATERIALS [9]

Abrasives – Moh's scale of hardness – types – natural [Diamond] – synthetic [SiC]; Refractories – characteristics – classifications [Acidic, basic and neutral refractories] – properties – refractoriness – RUL – porosity – thermal spalling; Lubricants – definition – function – characteristics – properties – viscosity index, flash and fire points, cloud and pour points, oiliness; Solid lubricants – graphite and MoS_2; Nano materials – CNT– synthesis [CVD, laser evaporation, pyrolysis] – applications – medicine, electronics, biomaterials and environment.

UNIT - II ELECTROCHEMISTRY AND CORROSION [9]

Introduction – electrode potential – Nernst equation – EMF series and its significance – types of cells (Electrolytic & electrochemical); Corrosion – causes, consequences – classification – chemical corrosion – electro chemical corrosion – mechanism; Galvanic & differential aeration corrosion – factors influencing corrosion – corrosion control – corrosion inhibitors.

UNIT - III CHEMICAL THERMODYNAMICS [9]

Terminology of thermodynamics – second law; Entropy – entropy change for an ideal gas – reversible and irreversible processes – entropy of phase transition – Clausius inequality; Free energy and work function – Helmholtz and Gibb's free energy functions (Problems) – criteria of spontaneity; Gibb's – Helmholtz equation (Problems) – Clausius-Clapeyron equation; Maxwell's relations – Van't Hoff isotherm and isochore (problems).

UNIT - IV ATOMIC STRUCTURE AND CHEMICAL BONDING [9]

Effective nuclear charge – orbitals – variations of s, p, d and f orbital – electronic configurations – ionization energy – electron affinity and electro negativity; Types of bonding – ionic, covalent and coordination bonding – hydrogen bonding and its types; Crystal field theory – the energy level diagram for transition metal complexes ($[Fe(CN)_6]^{3-}$, $[Ni(CN)_4]^{2-}$ and $[CoCl_4]^{2-}$ only); Role of transition metal ions in biological system; Band theory of solids.

UNIT - V PHOTOCHEMISTRY AND SPECTROSCOPIC TECHNIQUES [9]

Laws of photochemistry – Grotthuss Draper law – Stark-Einstein law – Beer-Lambert law – phosphorescence – fluorescence and it's applications in medicine – chemiluminescence; Colorimetry – principle – instrumentation (block diagram only) – estimation of iron by colorimetry; principles of spectroscopy – selection rules – vibrational and rotational spectroscopy – applications; Flame photometry – principle – instrumentation (block diagram only) – estimation of sodium; Atomic absorption spectroscopy – principle – instrumentation (block diagram only) – estimation of nickel.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Make use of the manufacture, properties and uses of advanced engineering materials.
CO2: Recognize the knowledge on the concept of corrosion and its control.
CO3: Assess knowledge about thermodynamics.
CO4: Rationalize periodic properties such as ionization energy, electron affinity and electro negativity.
CO5: Recognize the usage of various spectroscopic techniques.

Text Book:

1 Dr. A. Ravikrishnan, Engineering Chemistry, Srikrishna Hi-tech Publishing Company Private Limited, Chennai, Seventeenth Edition, 2016.

2 P.C. Jain and Monica Jain, Engineering Chemistry, Dhanpat Rai Publishing company, New Delhi, Seventeenth Edition, 2015

Reference Books:

1 S S. Dara and S. S. Umare, A Text book of Engineering Chemistry, S. Chand & Company Limited, New Delhi, Fifth Edition, 2015.

2 N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, PHI Learning Private Limited, New Delhi, Third Edition, 2014.

3 S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India Private Limited, New Delhi, First Edition, 2013.

4 B. Sivasankar, Engineering Chemistry, Tata McGraw – Hill Education Private Limited, New Delhi, First Edition, 2008.

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SEMESTER - II

		L	T	P	C
18AU214	**FUNDAMENTALS OF ENGINEERING MECHANICS**	3	1	0	4

Prerequisite: -

Objective:

- *To determine the resultant forces and its equilibrium acting on a particle in 2D and 3D using various methods.*
- *To apply the concept of reaction forces and moment of various support systems with rigid bodies in 2D and 3D in equilibrium.*
- *To find out area moments of inertia for the sections and mass moment of inertia of solids.*
- *To solve the problems using equation of motions and analyze impact of elastic bodies on collision.*
- *To apply the concept of frictional forces at the contact surfaces of various engineering systems.*

UNIT – I BASICS AND STATICS OF PARTICLES [12]

Introduction – Units and dimensions – Laws of mechanics – Lami's theorem, parallelogram and triangular law of forces – Vectorial representation of forces – Vector operations of forces – additions, subtraction, dot product, cross product – Coplanar forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT – II EQUILIBRIUM OF RIGID BODIES [12]

Free body diagram – Types of supports – Action and reaction forces – stable equilibrium – Moments and couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force – Equilibrium of rigid bodies in two dimensions – Equilibrium of rigid bodies in three dimensions.

UNIT – III PROPERTIES OF SURFACES AND SOLIDS [12]

Determination of areas and volumes – First moment of area and centroid of sections – simple and compound sections by using standard formula – second and product moments of plane area – simple and compound sections by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia.

UNIT – IV DYNAMICS OF PARTICLES [12]

Displacements, velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's laws of motion – D'Alembert's principle – Work energy equation – Impulse and momentum – Impact of elastic bodies.

UNIT – V FRICTION [12]

Friction force – Types of friction – Laws of Coulomb friction – Angle of repose – Simple contact friction – wedge friction, Screw friction, Rolling resistance, Ladder friction, Belt friction.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recall the fundamental knowledge on the laws of mechanics and identify the equilibrium conditions of particles to find the resultant force for the given system of forces.

CO2: Analyze the various types of supports and their reactions to different loading conditions.

CO3: Apply the parallel and perpendicular axis theorems to find out moment of inertia and polar moment of inertia of various sections.

CO4: Analyze the relation motion, curvilinear motion, projectile motion, Newton's law, D'Alembert's principle and work energy equation.

CO5: Recognize the concept of friction at the contact surfaces of various engineering systems.

Text Book:

1 Beer, F.P and Johnston Jr. E.R., Vector Mechanics for Engineers (In SI Units): Statics and Dynamics, Tata McGraw-Hill Education, New Delhi, Eleventh Edition, 2017.

2 Vela Murali, Engineering Mechanics, Oxford University Press, India, 2010.

Reference Books:

1 Hibbeller. R.C and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, Pearson Education, India, Eleventh Edition, 2010.

2 Irving H. Shames and Krishna Mohana Rao. G., Engineering Mechanics – Statics and Dynamics, Pearson Education, India, Fourth Edition, 2005.

3 Rajasekaran S and Sankarasubramanian G., Engineering Mechanics Statics and Dynamics, Vikas Publishing House Pvt. Ltd., Chennai, Third Edition, 2005.

4 Kumar, K.L., Engineering Mechanics, Tata McGraw-Hill, New Delhi, Third Revised Edition, 2008.

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SEMESTER – II

		L	T	P	C
18CS041	**PROGRAMMING FOR PROBLEM SOLVING** (Common to AU,CE,EC, EE & ME)	3	0	0	3

Prerequisite: -

Objectives:

- *To learn the organization of a digital computer and problem solving.*
- *To study basics of C programming.*
- *To discover the knowledge of arrays and strings.*
- *To know the concepts of functions and pointers.*
- *To gain the knowledge of structures, unions and file.*

UNIT - I BASICS OF COMPUTER AND PROBLEM SOLVING [9]

Generation and Classification of Computer – Organization of Digital Computer – Categories of Software – Software Development Life Cycle – Number System and Conversions – Representation of an Algorithm: Pseudo code, Flowchart with examples – Steps in Problem Solving – Problem Solving Strategies.

UNIT - II C PROGRAMMING BASICS [9]

Fundamentals – Structure of a C program – Compilation and Linking processes – Constants, Variables – Data Types – Operators – Expressions – Managing Input and Output operations – Decision Making and Branching – Looping statements – Simple Programs.

UNIT - III ARRAYS AND STRINGS [9]

Arrays: Introduction, One Dimensional Array, Declaration – Initialization of One Dimensional Array, Two-Dimensional Arrays, Initializing Two Dimensional Arrays – Simple Programs. String: Declaring and Initializing String Variables – String handling Functions and Operations.

UNIT - IV FUNCTIONS AND POINTERS [9]

Function: Declaration – Definition – Categories – Pass by Value – Pass by Reference – Recursion – Pointers: Definition – Initialization – Pointers arithmetic – Pointers to Pointers – Pointers and Arrays – Simple Programs.

UNIT - V STRUCTURES AND UNIONS [9]

Structures: Declaration – Definition – Structure within a structure – Union – Storage Classes – Preprocessor Directives – Files: Defining and Opening a file – Closing a file – Input/output operations on files – Command line arguments.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify basics of computer and problem solving.
CO2: Summarize the basics of C programming.
CO3: Design and Implement C programs for arrays and strings.
CO4: Demonstrate efficient programs using functions and pointers
CO5: Implement simple C applications using structures, unions and file.

Text Books :

1 Herbert Schildt, C - The Complete Reference, Tata McGraw-Hill, New Delhi, Fourth Edition, 2013.
2 R.G.Dromey, How to Solve it by Computer, Pearson Education, India, Fifth Edition, 2008.

References :

1 Ashok N.Kamathane, Computer Programming, Pearson Education, India, Second Edition 2014.
2 PradipDey, ManasGhosh, Fundamentals of Computing and Programming in C, Oxford University Press, England First Edition, 2013.
3 Anita Goel and Ajay Mittal, Computer Fundamentals and Programming in C, Dorling Kindersley India Pvt. Ltd., Pearson Education in South Asia, Second Edition, 2013.
4 Nptel.ac.in/courses/106104128/

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SEMESTER – II

		L	T	P	C
18MC051	**CONSTITUTION OF INDIA** (Common to all branches)	3	0	0	0

Prerequisite: Nil

Objectives:

- *To promote harmony throughout the nation.*
- *To enables the supreme law and helps to maintain integrity in the society and to promote unity among the citizens to build a great nation.*
- *To learn about the fundamentals of our Indian constitution and their structure.*
- *To understand the formation of state government, union government, Indian Judiciary System and Election Commission.*
- *To provides a way of life. It includes fraternity, liberty, and equality as the notion of a happy life and which cannot be taken from each other.*

UNIT - I INTRODUCTION [9]

Historical Background – Significance of the Constitution - Making of the constitution – Constituent Assembly of India - Role of the constituent Assembly - Salient features of the constitution - Nature of Federal system.

UNIT - II FUNDAMENTAL RIGHTS AND DUTIES [9]

Preamble – Citizenship – Fundamental Rights – Fundamental Duties and Responsibilities – Directive Principles of State Policy - Procedure for Amendment.

UNIT - III UNION GOVERNMENT [9]

Union Government – President – Vice President – Prime Minister – Powers and Duties – Cabinet – Council of Ministers – Parliament - Functions – Lok Sabha – Rajya Sabha – Role of the Speaker.

UNIT - IV STATE GOVERNMENT [9]

State Government – The Governor – Council of Ministers and Chief Minister – Powers and Functions – State legislature – Local Governance.

UNIT - V JUDICIAL SYSTEM AND ELECTION COMMISION [9]

The Indian Judicial System – Supreme Court – High Courts of India – Judicial Review – Election Commission of India – Duties and Responsibilities – State Election Commissions – Roles and functions.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Categorize the emergence and evolution of Indian Constitution.
CO2: Comprehend the fundamental rights and duties of the Indian citizen.
CO3: Recognize and evaluate the Indian Political scenario amidst the emerging challenges.
CO4: Analyze the organs of the state in the contemporary scenario.
CO5: Asses about the Indian judiciary system and working of Election Commission

Text Book :

1 P.M. Bakshi,"The Constitution of India ", Universal law Publishing, New Delhi, Fifteenth Edition, 2018

2 D.D.Basu, "Introduction to the constitution india", Lexis nexis Publisher, New Delhi, Second Edition, 2015.

Reference Books :

1 Brij Kishore sharma,"Introduction to the constitution india", PHI Learning Pvt. Ltd, New Delhi, Seventh Edition, 2015.

2 Sharma B. K, "Introduction to the Constitution of India", PHI Learning Pvt. Ltd, New Delhi, Sixth Edition, 2011.

3 M. Laxmikanth, "Indian Polity", Tata McGraw Hill, New Delhi, Sixth Edition, 2017.

4 Prof. Mahendra Pal Singh, " Constitution of India", Eastern Book company, Lucknow, Thirteenth Edition, 2015.

5 P. K. Agarwal, " Constitution of India", Prabhat Publishers, New Delhi,n Second Edition, 2015.

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SEMESTER – II

		L	T	P	C
18CH028	**CHEMISTRY LABORATORY (Common to All Branches)**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To gain the practical knowledge and hands on experiences of understanding the principle of conductometric titration.*
- *To acquaint the students with the estimation of iron by spectrophotometry.*
- *To analyze the instrumental methods of chemical analysis.*
- *To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.*
- *To impart knowledge about the theoretical principles of corrosion in metals.*

LIST OF EXPERIMENTS:

1. Conductometric Titration – Strong Acid Vs. Strong Base.
2. Conductometric Titration – Mixture of Weak and Strong Acids Vs. Strong Base.
3. Conductometric Titration – Precipitation, $BaCl_2$ Vs. Na_2SO_4.
4. Estimation of Ferrous ion by Potentiometry – Fe^{2+} Vs $K_2Cr_2O_7$.
5. Estimation of Hydrochloric Acid by pH metry.
6. Estimation of Iron by Spectrophotometry.
7. Estimation of hardness in water by EDTA method.
8. Estimation of chloride in water sample by Argentometry.
9. Estimation of dissolved oxygen (DO) in water by Winkler's method.
10. Determination of rate of corrosion of mild steel by weight loss method.

Total : 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the principle of conductometric titration.
CO2: Determine the role of pH in quantitative analysis of a solution.
CO3: Perceive the knowledge of the concentration of Iron by electrochemical methods.
CO4: Analyze the application of water in various fields.
CO5: Identify the nature of corrosion process.

Text Book :

1 Department of Chemistry Staff members, Chemistry Laboratory Manual, K.S.R. College of Engineering, Tiruchengode, Third Edition, 2018.

2 I. Vogel, Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & sons, Newyork, Eighth Edition, 2014

Reference Books :

1 S. K. Bhasin and Sudha Rani, Laboratory Manual of Engineering Chemistry, Dhanpat Rai Publishing Company Private Limited, New Delhi, Third Edition, 2012.

2 I. Vogel and J. Mendham, Vogel's Textbook of Quantitative Chemical Analysis, Harlow, Prentice Hall, Sixth Edition, 2000.

3 G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denny, Vogel's Text book of quantitative analysis chemical analysis, Longman, Singapore publishers, Singapore, ELBS Fifth Edition, 1996.

4 B.S. Furniss, A.J, Hannaford, P.W.G. Smith and A.R. Tatchel, Vogels Textbook of practical organic chemistry, John Wiley & sons, Newyork, Fifth Edition, 1989.

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SEMESTER – II

		L	T	P	C
18CS027	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY** (Common to AU, CE, EC, EE & ME)	0	0	3	1

Prerequisite: -

Objectives:

- *To study and identification of PC hardware and interfacing components.*
- *To learn the basic concept of creating a table, flow chart, mail merge in a word document.*
- *To know spreadsheet for creating the charts and apply formulas and functions.*
- *To get knowledge of power point presentation with animations and generate a report in MS access.*
- *To gain the practical knowledge of how to implement C programs for simple application.*

List of Experiments:

1. Study and Identification of PC Motherboard and its interfacing components
2. Prepare a Bio-data using MS Word with appropriate page, text and table formatting options and send the same to many recipients using mail merge.
3. Prepare a mark sheet with five subjects for five students in MS Excel File using Formulas, Functions and charts.
4. i) Prepare a Power Point presentation for your organization with varying animation effects using timer.
   ii) Prepare a Student Database in MS Access, manipulate the data and generate report.

Implement the following program using Raptor tool and C

5. Generate Fibonacci series and compute factorial for a given number using looping statements. (While and do…while).
6. Consider the five subjects Physics, Chemistry, Biology, Mathematics and Computer. Calculate the average and grade according to following:
   Percentage >= 90%: Grade A
   Percentage >= 80%: Grade B
   Percentage >= 70%: Grade C
   Percentage >= 60%: Grade D
   Percentage >= 40%: Grade E
   Percentage < 40%: Grade F Using if … else & switch
7. Declare an array with N elements then delete given element from the array and display.
8. Maintain a record of 'n' employee details using an array of structures with four fields (Employee ID, Name, salary and designation). Assume appropriate data type for each field. Print the employee details.
9. Generate prime factors of an integer using functions.
10. Implement the following using pointer:

i) Arithmetic operations ii) Swapping of two variables.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Create a table, flow chart, mail merge and apply text manipulation in a word document
CO2: Construct a spreadsheet for creating the charts and apply formulas and functions.
CO3: Design power point presentation with animations and generate a report in MS access.
CO4: Apply good programming design methods for program development.
CO5: Design and implement C programs for simple applications.

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SEMESTER – II

18GE027	**WORKSHOP PRACTICES LABORATORY** (Common to AU,CE & ME)	L	T	P	C
		0	0	3	1

Prerequisite: *-*

GROUP A (CIVIL & MECHANICAL)

Objectives*:*

- *To study moulding operation and make simple carpentry works.*
- *To make welding of simple structures.*
- *To be practice of lathe and drilling operations.*

LIST OF EXPERIMENTS

1. Make Lap joint / Butt joint / T joint from the given wooden pieces using carpentry tools.
2. Make a Butt joint / Lap joint / Tee joints using arc / gas welding equipment.
3. Perform simple Facing and Turning operation using Centre Lathe.
4. Make holes as per the given dimensions using drilling machine.
5. Prepare a mould using solid/split patterns in Foundry.
6. Study of fitting, smithy, Plastic Moulding, and Glass cutting.

LIST OF EQUIPMENT

1.	Fitting tools and its accessories	-	15 Sets
2.	Carpentry tools and its accessories	-	15 Sets
3.	Smithy tools and Open hearth furnace setup	-	2 Sets
4.	Foundry tools and its accessories	-	5 Sets
5.	Arc Welding equipments and its accessories	-	5 Sets
6.	Oxy Acetylene welding setup and its accessories	-	1 Set
7.	Centre Lathe with its accessories	-	2 Nos.
8.	Pillar type drilling machine	-	1 No.

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

CO1: Prepare green sand mould for simple patterns and carpentry components with simple joints.
CO2: Perform welding practice to join simple structures.
CO3: Practice simple operations in lathe and drilling machine.

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SEMESTER – II

		L	T	P	C
18GE027	**GROUP B (ELECTRICAL & ELECTRONICS)** (Common to AU, CE, & ME)	0	0	3	1

Prerequisite: -

Objectives:

- *To study different types of wiring used in house.*
- *To learn the procedure for calibration of Single phase Energy meter*
- *To learn components in electronics, different logic gates and the working of CRO.*

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List of Experiments:

ELECTRICAL ENGINEERING

1. Fluorescent lamp wiring & Stair-case wiring.
2. Calibration of Single phase Energy meter

ELECTRONICS ENGINEERING

1. Study of Electronic components and Soldering practice.
2. Study of logic gates AND, OR, EX-OR, NOT, Half and Full Adder.
3. Study of CRO

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Construct different types of wiring used in house.
CO2: Calibrate single phase Energy meter.
CO3: Organize different electronic components, logic gates and verify its working.

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SEMESTER - III

18MA341	**STATISTICS AND NUMERICAL METHODS** (COMMON TO B.E. AU & ME)	L	T	P	C
		3	1	0	4

Prerequisite: *-*

Objectives:

- *To acquire knowledge in testing of hypothesis*
- *To study the concepts of design of experiments.*
- *To introduce the basic concepts of solving algebraic, transcendental and simultaneous equations.*
- *To study the techniques of numerical differentiation and integration*
- *To study the concepts of solving initial value and boundary value problems for ordinary differential equations.*

UNIT - I **TESTING HYPOTHESIS** **[12]**

Sampling distributions - Tests for single mean and difference of means - Test for single variance and difference of variances - 't' distribution - Chi-square test for Goodness of fit and Independent of Attributes - F distribution.

UNIT - II **DESIGN OF EXPERIMENTS** **[12]**

One way and two way classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design.

UNIT - III **SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS** **[12]**

Solution to algebraic and transcendental equations - Newton-Raphson method, Regula-falsi method - Solutions to simultaneous linear equations - Gauss Elimination method - Gauss-Seidel method - Eigen value of a matrix by Power method.

UNIT - IV **NUMERICAL DIFFERENTIATION AND INTEGRATION** **[12]**

Numerical differentiation using Newton's forward and backward interpolation methods - Numerical integration by Trapezoidal and Simpson's 1/3rd and 3/8th rule - Double integrals using trapezoidal rule and Simpson's rule.

UNIT - V **INITIAL AND BOUNDARY VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** **[12]**

Solving first order Ordinary Differential Equations - Euler's and Modified Euler's Method - Fourth order Runge-Kutta Method - Milne's predictor and corrector method - Finite difference solution of second order ordinary differential equation.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Develop their skills in testing of hypothesis for small and large samples in real life problems.
CO2: Develop the basic concepts of classifications of design of experiments in the field of agriculture.
CO3: Apply the numerical techniques for solving algebraic, transcendental and simultaneous equations.
CO4: Solve the numerical differentiation and integration problems.
CO5: Solve the ordinary differential equations with initial conditions and boundary conditions numerically.

Text Books:

1. Grewal. B.S. and Grewal. J.S., Numerical Methods in Engineering and Science, Khanna Publishers, New Delhi, Tenth Edition, 2015.
2. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, New Delhi, Fortieth Edition, 2014

References:

1. Burden, R.L and Faires, J.D, Numerical Analysis, Cengage Learning, New Delhi, Ninth Edition, 2016.
2. Devore. J.L., Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, Eighth Edition, 2016.
3. P. Kandasamy, K. Thilagavathy, K. Gunavathy Numerical Methods, S. Chand Company, New Delhi, Fifth Edition, 2016.
4. S.R.K. Iyengar, R.K.Jain, Numerical Methods, New Age International Publishers, New Delhi, First Edition, 2015.

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SEMESTER – III

		L	T	P	C
18EE041	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING** (Common to AU,CE,CS, IT & ME)	3	0	0	3

Prerequisite: *Engineering Mathematics, Engineering Physics*.

Objectives:

- To study the basic concepts of electric circuits and various measuring instruments.
- To familiarize the constructional details and operation of the DC machines and transformers.
- To impart knowledge on AC Motors and special electrical machines.
- To understand the basic of various measuring instruments.
- To study the characteristics of semiconductor devices and its applications.

UNIT - I ELECTRICAL CIRCUITS [9]

Structure of Electrical Power System– Ohm's Law – Kirchhoff's Laws – Circuit Analysis – Introduction to AC Circuits: R, RL & RLC series circuits (Quantitative Approach Only), Average and RMS Value – Power factor for single phase Circuits – Three Phase Star and Delta Connections – Electrical Safety.

UNIT - II DC MOTORS AND TRANSFORMERS [9]

Faraday's Law – Lenz's Law - Fleming's left hand and right hand rule, DC Motors: Construction – Operation – Series and Shunt Motor – Characteristics - Applications. Single Phase Transformer: Construction – Operation – EMF Equation – Types - Applications.

UNIT - III AC MOTORS & SPECIAL MACHINES [9]

Single Phase Induction Motor: Construction – Operation – Split Phase Induction Motor and Capacitor Start Induction Run Motor – Applications, Three Phase Induction Motor: Construction – Operation – Types – Applications. Special Machines: Stepper Motor.

UNIT - IV MEASURING INSTRUMENTS [9]

Basic Methods of Measurements: Direct and Indirect , Functional elements of an instrument – Errors in measurements – Analog and Digital Instruments – Basic Principle of Indicating Instruments – Moving Coil and Moving Iron Ammeter and Voltmeter. Dynamometer type Wattmeter – Induction type Energy Meter – Cathode Ray Oscilloscope.

UNIT - V ANALOG AND DIGITAL ELECTRONICS [9]

Semiconductor devices: PN Junction Diode, Zener diode: classification, operation and Characteristics - Bipolar Junction Transistor – CE Configurations and its Characteristics. Review of number systems – digital logic gates – Introduction to Micro processors.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Solve the electric circuits by applying basic circuital laws using various combinations of circuit elements.

CO2: Explain the construction, operating principle and application of DC motor, transformers.

CO3: Enlighten the construction, operating principle and application of AC motors.

CO4: Illustrate the function of various measuring instruments.

CO5: Discuss the characteristics of Diodes, Zener diode, BJT using CE configurations

Text Books :

1 Smarajit Ghosh,Fundamentals of Electrical and Electronics Engineering, PHI Learning Private Limited, New Delhi, Second Edition, 2007.

2 V.Jegathesan, K.Vinothkumar and R.Saravanakumar, Basic Electrical and Electronics Engineering, Wiley India Publication, New Delhi, First Edition, 2012.

References :

1 Muthusubramanian,R., Salivahanan S and Muraleedharan, K.A., Basic Electrical, Electronics and Computer Engineering, Tata McGraw Hill Publishing Co Ltd., New Delhi, Second Edition, 2006.

2 Nagsarkar T K and Sukhija M S,Basics of Electrical Engineering, Oxford University Press, London, Ninth Edition, 2005.

3 Mehta, V.K and Rohit Mehta, Principle of Electrical Engineering, S Chand & Company, New Delhi, Second Edition 2008.

4 Mahmood Nahvi and Joseph A. Edminister, Electric Circuits, Schaum' Outline Series, Tata McGraw Hill Publishing Co Ltd., New Delhi, Fifth Edition, 2002.

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SEMESTER - III

		L	T	P	C
18AU313	**MECHANICS OF MATERIALS**	3	1	0	4

Prerequisite: Fundamentals of Engineering Mechanics

Objectives:

- *To comprehend the concepts of stress, strain, principal stresses and principal planes.*
- *To study the concept of shearing force and bending moment due to external loads in determinate beams and their effects on stresses.*
- *To compute slopes and deflection in determinate beams by various methods.*
- *To determine stresses and deformation in circular shafts and helical spring due to torsion.*
- *To study the stresses and deformations induced in thin and thick shells.*

UNIT – I STRESS STRAIN DEFORMATION OF SOLIDS [12]

Mechanical properties of metals – Rigid and deformable bodies – Strength, stiffness and stability – Stresses; Tensile, compressive and shear – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads – Deformation of simple and compound bars under axial load – Thermal stress and strain.

UNIT – II BEAMS – LOADS AND STRESSES [12]

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 – Shear stresses in beams.

UNIT – III BEAM DEFLECTION AND COLUMNS [12]

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 – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT – IV TORSION – SHAFT AND SPRINGS [12]

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 – V ANALYSIS OF STRESSES IN TWO DIMENSIONS [12]

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 (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2: Identify the load transmitting mechanism in beams and stress distribution due to shearing force and bending moment.

CO3: Analyze the slope and deflection in beams and columns using different methods.

CO4: Apply basic equation of simple torsion in designing of shafts and springs.

CO5: Design and analyze thin and thick shells for the applied internal and external pressures.

Text Book :

1 Bansal R.K., A Textbook of Strength of Materials, Laxmi Publications (P) ltd, New Delhi, Sixth Edition, 2018.

2 Rajput R.K, Strength of materials (Mechanics of Solids) SI Units , S.Chand & Company Ltd, New Delhi, Seventh Edition, 2018.

Reference Books :

1 Beer F. P. and Johnston E, Mechanics of Materials, Tata McGraw-Hill Education, New Delhi, Seventh Edition, 2014.

2 Popov E.P, Engineering Mechanics of Solids, Prentice-Hall of India, New Delhi, Second Edition, 2012.

3 Subramanian R, Strength of Materials, Oxford University Press, New Delhi, Third Edition, 2016.

4 Hibbeler, R.C, Mechanics of Materials, Pearson Education, New Delhi, Ninth Edition, 2018.

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SEMESTER - III

		L	T	P	C
18AU314	**FLUID MECHANICS AND HYDRAULIC MACHINES**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To study the properties of fluids and concept of control volume.*
- *To comprehend the concepts of boundary layer concepts and flow through pipes.*
- *To get expose to dimensional analysis and model studies.*
- *To illustrate the working principle of hydraulic turbines.*
- *To analyze the performance behaviour of hydraulic pumps.*

UNIT – I FLUID PROPERTIES AND FLOW CHARACTERISTICS [9]

Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Flow characteristics – Concept of control volume – Application of continuity equation, energy equation and momentum equation.

UNIT – II FLOW THROUGH PIPES [9]

Laminar and turbulent flow characteristics, laminar flow through the circular pipes – Boundary layer concepts – Types of boundary layer thickness – Hydraulic and energy gradient – Darcy Weisbach equation – Friction factor – Moody diagram – Minor losses – Flow through pipes in series and parallel.

UNIT – III DIMENSIONAL AND MODEL ANALYSIS [9]

Dimensional analysis: Dimensions, dimensional homogeneity, methods of dimensional analysis – Buckingham Pi theorem. Model analysis – Advantages and applications of model testing. Similitude, types of similitude – Dimensionless parameters – Application of dimensionless parameters – Model laws.

UNIT – IV HYDRAULIC TURBINES [9]

Impact of jets – Euler's equation – Theory of roto-dynamics machines – Velocity components at entry and exit of the rotor – Velocity triangles. Classification of turbines – Heads and efficiencies – Velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines – Working principles – Work done by water on the runner – Draft tube. Specific speed – Unit quantities – Performance curves for turbines.

UNIT – V HYDRAULIC PUMPS [9]

Centrifugal pumps – Working principle – Work done by the impeller – Performance curves. Reciprocating pump – Working principle – Indicator diagrams – Work saved by air vessels. Rotary pumps – Classification. Working and performance curves.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply mathematical knowledge to predict the properties and flow characteristics of a fluid.
CO2: Analyze the boundary layer concepts and major and minor losses associated with pipe flow.
CO3: Interpret the results of dimensional and model analysis.
CO4: Illustrate the operation and performance of various hydraulic turbines.
CO5: Evaluate the performance and operation of hydraulic pumps.

Text Book :

1 Bansal R.K, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd., New Delhi, Tenth Edition, 2018.

2 Rajput R.K, A Textbook of Fluid Mechanics and Hydraulic Machines, S.Chand & Company Ltd., New Delhi, Sixth Edition, 2016.

Reference Books :

1 Modi.P.N. and Seth.S.M, Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, Twenty-first Edition, 2017.

2 Kumar. K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd., New Delhi, Seventh Edition, 2016.

3 V.L. Streeter and Wylie E.B., Fluid Mechanics, Tata McGraw-Hill Education, New Delhi, Ninth Edition, 2017.

4 Rathakrishnan. E, Fluid Mechanics: An Introduction, Prentice Hall India Learning Private Limited, New Delhi, Third Edition, 2007.

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SEMESTER - III

		L	T	P	C
18AU315	**AUTOMOTIVE MANUFACTURING TECHNOLOGY**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the various moulding and casting processes.*
- *To acquire the knowledge on various welding processes.*
- *To illustrate the machining processes.*
- *To infer about the various forming and shaping processes of plastics.*
- *To study about the metal forming and power metallurgy processes.*

UNIT – I CASTING [9]

Casting types, procedure to make sand mould, types of core making, moulding tolls, machine moulding, special moulding processes – CO_2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects, Application of castings in Automobile.

UNIT – II WELDING [9]

Soldering, brazing and welding – Fusion welding, gas welding – Flame types – Process of arc welding – Electrode – Filler material – Flux – Edge preparation – Joints – Position – Welding symbol – GMAW – GTAW – Resistance welding – Spot, seam, butt and projection – Stud welding – Friction welding – Submerged arc welding – Electro slag welding.

UNIT – III MACHINING [9]

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe – shaper – planer – horizontal milling machine – universal drilling machine – cylindrical grinding machine – Capstan and turret lathe.

General principles and applications of the following processes: Abrasive jet machining – ultrasonic machining – electric discharge machining – electro chemical machining – plasma arc machining – electron beam machining and laser beam machining.

UNIT – IV FORMING AND SHAPING OF PLASTICS [9]

Types of plastics – Characteristics of the forming and shaping processes – Moulding of thermoplastics – Working principles and typical applications of – Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion – Typical industrial applications – Thermoforming – Processing of thermosets – Working principles and typical applications – Compression moulding – Transfer moulding – Bonding of thermoplastics – Fusion and solvent methods – Induction and ultrasonic methods.

UNIT – V METAL FORMING AND POWDER METALLURGY [9]

Hot and cold forming – Forging – Rolling – Extrusion – Spinning – Wire drawing, powder metallurgy – Steps – Sintering – Merits – demerits and applications. Types of dies – Progressive and combination die.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Outline the various moulding and special casting processes and identify the defects that occur during the process.
CO2: Identify the welding processes used for manufacturing components.
CO3: Demonstrate the various machining processes to enhance the productivity.
CO4: Discuss various fabrication techniques for manufacturing components.
CO5: Familiarize the metal forming and power metallurgy process for making components.

Text Book :

1 Hajra Choudhury, Elements of Workshop Technology, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2008.
2 Sharma P.C., A Text Book of Production Technology: Manufacturing processes, S.Chand & Company Ltd, New Delhi, Eighth Revised Edition, 2014.

Reference Books :

1 Jain. R.K and Gupta. S.C., Production Technology, Khanna Publishers, New Delhi, Sixth Edition, 2001.
2 H.M.T. Production Technology – Handbook, Tata McGraw-Hill Education, New Delhi, 2001.
3 Roy. A. Linberg, Process and Materials of Manufacture, Prentice Hall India Learning Private Limited, New Delhi, 2000.
4 Adithan. M and A.B. Gupta, Manufacturing Technology, New Age International (P) Ltd, New Delhi, Fifth Edition, 2012.

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SEMESTER - III

		L	T	P	C
18AU316	**AUTOMOTIVE CHASSIS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To study about the constructional details of chassis and frames.*
- *To illuminate the steering system and steering gear boxes used in the automotive.*
- *To acquire the knowledge about the transmission systems.*
- *To evaluate the working principle of suspension systems.*
- *To infer about the various braking systems.*

UNIT – I CHASSIS AND FRAMES [9]

Types of chassis layout with reference to power plant locations and drives, vehicle frames, various types of frames, constructional details, materials, testing of vehicle frames, unitized frame body construction. Types of front axles, construction details, materials.

UNIT – II STEERING SYSTEM [9]

Steering geometry: castor, camber, king pin inclination, toe-in. conditions for true rolling motion of wheels during steering, steering geometry, Ackermann and Davis steering system, constructional details of steering linkages, different types of steering gear boxes, steering linkages and layouts, turning radius, wheel wobble, power assisted steering.

UNIT – III DRIVE LINE [9]

Effect of driving thrust and torque reactions, Hotchkiss drive, torque tube drive and radius rods, propeller shaft, universal joints, front wheel drive, different types of final drive, double reduction and twin speed final drives, differential principle, construction details of differential unit, non-slip differential, differential locks, differential housings, construction of rear axles, types of loads acting on rear axles, fully floating, three quarter floating and semi floating rear axles, rear axle housing, construction of different types of axle housings, multi axle vehicles.

UNIT – IV SUSPENSION SYSTEM [9]

Need of suspension system, types of suspension, suspension springs, constructional details and characteristics of leaf, coil and torsion bar springs, independent suspension, dependent suspension, rubber suspension, pneumatic suspension, shock absorbers.

UNIT – V BRAKING SYSTEM [9]

Classification of brakes, drum brakes and disc brakes, constructional details, theory of braking, concept of dual brake system, parking brake, mechanical, hydraulic system, vacuum assisted system, air brake system, antilock braking, EBD, combi braking system, retarded engine brakes, eddy retarders.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Outline the construction details of various automotive chassis frame layouts.
CO2: Explain the function of steering system and steering gear box used in automotive.
CO3: Comprehend the construction and functions of transmission systems.
CO4: Identify the suspension systems.
CO5: Distinguish various types of braking systems.

Text Book :

1 Heldt. P.M, Automotive Chassis, Chilton Co., New York, 1990

2 K.K.Ramalingam, Automobile Engineering, Scitech Publications (India) Pvt. Ltd, Chennai, 2011.

Reference Books :

1 Newton K, Steeds W and Garret T.K, Motor Vehicles, Butterworth-Heinemann, London, Thirteenth Edition, 2000.

2 Heinz Hazler, Advanced Vehicle Technology, Butterworth-Heinemann, London, Second Edition, 2005.

3 Crouse W.H, Automotive Chassis and Body, Tata McGraw-Hill Inc, New York, Fifth Edition, 1976

4 Giri. N.K., Automotive Mechanics, Khanna Publishers, New Delhi, Eighth Edition, 2008.

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SEMESTER - III

		L	T	P	C
18AU321	**FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To provide practical knowledge in verification of discharge of fluid flow.*
- *To gain the knowledge about discharge of fluid flow.*
- *To comprehend the major losses in the pipe flow.*
- *To illustrate the performance behaviour of hydraulic pumps.*
- *To examine the performance behaviour of hydraulic turbines.*

List of Experiments:

1. Determination of the coefficient of discharge of given Orifice meter.
2. Determination of the coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter and Pitot-tube.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristics curves of centrifugal pump.
6. Conducting experiments and drawing the characteristics curves of reciprocating pump.
7. Conducting experiments and drawing the characteristics curves of gear pump.
8. Conducting experiments and drawing the characteristics curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristics curves of Kaplan turbine.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Compute the coefficient of discharge of Orifice meter and Venturi meter.
CO2: Estimate the rate of flow of fluid by Rota meter and Pitot-tube.
CO3: Evaluate the major losses of fluid flow through pipes.
CO4: Analyze the performance of centrifugal pump, reciprocating pump and gear pump.
CO5: Carryout the performance analysis and draw the characteristic curves of Pelton wheel, Francis turbine and Kaplan turbine.

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SEMESTER - III

		L	T	P	C
18AU322	**MANUFACTURING TECHNOLOGY LABORATORY**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To get hands on experience in the conventional machines.*
- *To develop the basic parts using shaper and slotter machines*
- *To prepare the process planning sheets for drilling, reaming and tapping operations and then follow the sequences during the machining processes.*
- *To identify the appropriate operations in milling machine to perform machining processes.*
- *To comprehend the grinding process to make the basic parts.*

List of Experiments:

1. LATHE

1.1. Facing, plain turning and step turning.

1.2. Taper turning and knurling operation.

1.3. Thread cutting operation.

1.4. Boring and internal thread cutting.

2. SHAPER

2.1. Machining to make a cube.

2.2. Machining to make a V-Block.

3. SLOTTER

3.1. Machining an internal or external key-way.

4. DRILLING

4.1. Drilling multiple holes at a given pitch circle on a plate.

4.2. Drilling, reaming and tapping.

5. MILLING

5.1. Plain milling

5.2. Gear milling

6. GRINDING

6.1. Cylindrical Grinding

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Create the basic parts using conventional machines like lathe.

CO2: Interpretation of process plan sheets to be followed for the machining of products using shaper and slotter machines.

CO3: Identify the appropriate operations like drilling, reaming and tapping to make the basic parts.

CO4: Apply the appropriate method and machine tools for performing milling operations.

CO5: Demonstrate the appropriate method and machine tools for performing grinding operations.

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SEMESTER - III

		L	T	P	C
18AU323	**MECHANICS OF MATERIALS LABORATORY**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To study the experimental data include universal testing machine and torsion equipment.*
- *To determine stress analysis and design of beams subjected to bending and shearing loads using several methods.*
- *To infer the experimental data for compression testing machine, hardness tester.*
- *To examine the experimental stress with fatigue tests using impact testing machine.*
- *To analyze the experimental data for spring testing machine and to calculate the flexural strength of a beam.*

List of Experiments:

1. Tension test on a mild steel rod.
2. Double shear test on mild steel and aluminium rods.
3. Torsion test on a mild steel rod.
4. Impact test on metal specimen – Izod test.
5. Impact test on metal specimen – Charpy test.
6. Hardness test on metals – Brinell Hardness Number.
7. Hardness test on metals – Rockwell Hardness Number.
8. Deflection test on beams.
9. Compression test on helical springs.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Evaluate the properties of materials using tension test and torsion test.
CO2: Acquire knowledge in the area of testing of materials experimentally by shear stress test.
CO3: Analyze the mechanical behaviour of materials using hardness test.
CO4: Evaluate the fatigue properties of given specimens by impact testing.
CO5: Calculate the tensile stress using spring testing machine and to find deflection of different section of beams at different loading conditions.

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SEMESTER - III

		L	T	P	C
18HR351	**CAREER DEVELOPMENT SKILLS - I** (Common to All Branches)	0	2	0	0

Prerequisite: -

Objectives:

- *To help individuals cope with continued changes in the world of work.*
- *To help individuals understand their unique abilities, interests, and aptitudes.*
- *Ability to speak, express and interact in the society and place of study.*
- *Critically interpret and comprehend a given text.*
- *Ability to make extempore speech.*

UNIT – I EFFECTIVE ENGLISH – SPOKEN ENGLISH [6]

Basic Rules of Grammar – Parts of Speech – Tenses – Verbs – Sentences construction - Vocabulary – idioms & phrases – Synonyms – Antonyms – Dialogues and conversation – Exercise(Speaking).

UNIT – II ESSENTIAL COMMUNICATION [6]

Verbal communication – Effective communication – Active Listening – Paraphrasing – Feedback, Non Verbal Communication – Body language of self and Others, Important of feelings in communication – Dealing with feelings in communication practice - Exercise

UNIT – III WRITTEN COMMUNICATION – PART 1 [6]

Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition – Change of Voice – Change of Speech – One word Substitution – Using the same word as different parts of speech – Odd Man Out – Spelling & Punctuation (Editing)

UNIT – IV WRITTEN COMMUNICATION – PART – 2 [6]

Analogies – Sentences Formation – Sentence Completion – Sentence Correction – idioms & Phrases – Jumbled Sentences, Letter Drafting (Formal Letters) – Reading Comprehension (Level 1) – Contextual Usage – Foreign Languages Words used in English – Exercise.

UNIT – V ORAL COMMUNICATION – PART – 1 [6]

Self introduction – Situational Dialogues / Role Play (Telephonic Skills) – Oral Presentations – Prepared –' Just A Minute' Sessions (JAM) – Presentation Skills – Exercise.

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Have competent knowledge on grammar with an understanding of its basic rules.
CO2: Communicate effectively and enhance interpersonal skills with renewed self – confidence.
CO3: Construct sentence in English and make correction.
CO4: Perform oral communication in any formal situation.
CO5: Develop their LSRW skills.

Text Book:

1 Anne Laws, Writing Skills, Orient Black Swan. Hyderabad, First Edition, 2011.

2 Sarah Freeman, Written Communication in English, Orient Black Swan, Hyderabad, First Edition, 2015

Reference Books :

1 M Ashra Rizvi, Effective Technical Communication, Tata McGraw HILL, New Delhi, First Edition, 2005.

2 Raj N Bakshmi, English Grammar Practice, Orient Black Swan, Hyderabad, First Edition, 2009.

3 Norman Lewis. W.R., "Word Power Made Easy", Goyal Publications

4 Thakur K B Sinha, Enrich Your English, Vijay Nicole, Chennai, First Edition, 2005.

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SEMESTER - IV

		L	T	P	C
18AU411	**ENGINEERING THERMODYNAMICS AND HEAT TRANSFER** (Use of Standard and approved Steam Tables, Mollier Chart and Refrigeration Tables, Heat and Mass Transfer data book is permitted)	3	1	0	4

Prerequisite: Applied Physics and Engineering Chemistry

Objectives:

- *To comprehend the basic and application of first law of thermodynamics.*
- *To acquire the knowledge on the second law of thermodynamics in analyzing the performance of thermal devices.*
- *To analyse the air standard cycles and summary the concept of refrigeration cycles.*
- *To infer the mechanism of heat transfer under steady state conditions.*
- *To analyse the concept and principles of convective and radiation heat transfer.*

UNIT – I FIRST LAW OF THERMODYNAMICS [12]

System, thermodynamic equilibrium, state, property, process, cycle, Zeroth law of thermodynamics, energy, work, heat, first law of thermodynamics, PMM1, ideal gases, application of first law of thermodynamics to closed and open systems, Steady flow process and application of steady flow energy equation.

UNIT – II SECOND LAW OF THERMODYNAMICS [12]

Statements of second law of thermodynamics, PMM2, Clausius inequality, heat engine, heat pump, refrigerator, Carnot cycle, Carnot theorem, entropy, temperature – entropy diagram and entropy changes for a closed system. Properties of pure substances.

UNIT – III GAS POWER CYCLES AND VAPOUR POWER CYCLES [12]

Air standard cycles – Otto, Diesel, Dual – work output, Efficiency and MEP calculations, Standard Rankine cycle, Reheat and Regenerative cycle.

Fundamentals of refrigeration, C.O.P, simple vapour compression refrigeration system, simple vapour absorption refrigeration system and desirable properties of an ideal refrigerant.

UNIT – IV CONDUCTION [12]

Basic concepts – Mechanism of heat transfer – Conduction, Convection and Radiation – General differential equation of heat conduction – Fourier law of conduction – One dimensional steady state heat conduction – Conduction through plane wall, cylinders – Composite systems – Extended surfaces – Simple problems.

UNIT – V CONVECTION AND RADIATION [12]

Basic concepts – Types of convection – Forced convection – External flow – Flow over plates, cylinders – Free convection – Flow over vertical plate, horizontal plate, cylinders.

Basic concepts, Laws of radiation – Stefan Boltzman law, Kirchoff law – Black body radiation – Grey body radiation – Radiation shields.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the first law of thermodynamics for simple open and closed systems under steady state conditions.

CO2: Evaluate the second law of thermodynamics to open and closed systems, calculate entropy and establish relations between ideal and real gases.

CO3: Analyse the thermodynamic concepts to different air standard cycles and solve problems using refrigerant table.

CO4: Identify the mechanisms of heat transfer under steady state conditions.

CO5: Interpret and analyze the convective and radiation heat transfer.

Text Book :

1 Nag P.K, Engineering Thermodynamics, Tata McGraw-Hill Education, New Delhi, Sixth Edition, 2017.

2 Holman J.P, Heat and Mass Transfer, Tata McGraw Hill Education, New Delhi, Tenth Edition, 2017.

Reference Books :

1 Yunus A. Cengel and Michael A. Boles, Thermodynamics, Tata McGraw-Hill Education, New Delhi, Eighth Edition, 2015.

2 Rajput R.K, A Text Book of Engineering Thermodynamics, Laxmi Publications (P) Ltd, New Delhi, Fifth Edition, 2016.

3 Sachdeva R.C, Fundamentals of Engineering Heat and Mass Transfer, Fifth Edition, New Age International Pvt. Ltd., New Delhi, India 2017.

4 Kothandaraman.C.P, Fundamentals of Heat and Mass Transfer, New Age International Pvt. Ltd, New Delhi, Fourth Edition, 2012.

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SEMESTER - IV

		L	T	P	C
18AU412	**AUTOMOTIVE ENGINES**	3	0	0	3

Prerequisite: -

Objectives:

- *To acquire the knowledge on automotive SI and CI engines consisting of construction and working.*
- *To summarize various the fuel supply and injection systems used in SI and CI engines.*
- *To identify the suitable lubrication and cooling system to be used in IC engines.*
- *To explain the concepts of supercharging, turbocharging and engine testing*
- *To examine the combustion process and combustion chambers to improve the performance of the IC engines.*

UNIT – I CONSTRUCTION AND OPERATION [9]

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

UNIT – II FUEL SYSTEMS [9]

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, Working of a simple fixed venturi carburetor, Multi Point Fuel Injection, Gasoline Direct Injection. Diesel fuel injection systems - Jerk pumps, distributor pumps, pintle, pintaux and multihole nozzles, Unit injector and CRDI systems. Injection pumps calibration. Need for a governor for diesel engines. Description of a simple diesel engine governor.

UNIT – III COOLING AND LUBRICATION SYSTEMS [9]

Need for cooling, types of cooling systems – air and liquid cooling systems. Thermosyphon, forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types – mist, pressure feed, dry and wet sump systems. Properties of lubricants.

UNIT – IV SUPERCHARGING , TURBOCHARGING AND ENGINE TESTING [9]

Supercharging and turbo charging, Different methods of turbo charging, Inter-cooling, turbocharger controls including, waster gate, variable geometry, variable nozzle types. Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies. Measurement of friction, cylinder pressure measurement. Engine performance maps, Engine testing standards.

UNIT – V COMBUSTION AND COMBUSTION CHAMBERS [9]

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

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the construction and working principle of SI and CI engines.
CO2: Outline the fuel supply and injection system used in SI and CI engines.
CO3: Examine the cooling and lubrication systems used in IC engines.
CO4: Describe the concepts of supercharging, turbo charging and engine testing.
CO5: Identify the combustion processes and combustion chambers to improve the performance of IC engines.

Text Book :

1 Ganesan. V, Internal Combustion Engines, Tata McGraw Hill Education, New Delhi, Fourth Edition, 2012.
2 Mathur M.L. and Sharma R.P, A Course in Internal Combustion Engines, Dhanpat Rai and sons, New Delhi, 2014.

Reference Books :

1 Ramalingam K.K, Automobile Engineering, Scitech Publications (India) Pvt. Ltd, Chennai, 2011.
2 John B. Heywood, Internal Combustion Engine Fundamentals, Tata McGraw Hill Education, New Delhi, 1998.
3 Gupta H.N, Fundamentals of Internal Combustion Engines, PHI Learning Private Ltd., New Delhi, Second Edition, 2013.
4 Obert, E.F., Internal Combustion Engineering and Air Pollution, Intext Education Publishers, 1988.

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SEMESTER - IV

		L	T	P	C
18AU413	**MATERIAL SCIENCE AND METALLURGY**	3	0	0	3

Prerequisite: Applied Physics and Engineering Chemistry

Objectives:

- *To construct the phase diagram and using of iron – iron carbide phase diagram for microstructure formation.*
- *To select the suitable treatment processes for the engineering materials.*
- *To apply the different polymer, ceramics, and composites and their uses in engineering field.*
- *To survey and report the materials used in automotive sector.*
- *To infer the various testing procedures and failure mechanism in engineering field.*

UNIT – I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS [9]

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast iron microstructure, properties and applications.

UNIT – II HEAT TREATMENT [9]

Full annealing, stress relief, recrystallization, spheroidizing, normalizing and tempering. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram, Critical Cooling Rate - Hardenability, Jominy end quench test – Austempering and martempering. Case hardening - carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening.

UNIT – III NON-METALLIC MATERIALS [9]

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS,PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics –Introduction to Fibre reinforced plastics.

UNIT – IV MATERIALS FOR AUTOMOTIVE COMPONENTS [9]

Criteria of selecting materials for automotive components viz cylinder block, cylinder head, piston and piston ring. Gudgeon pin, connecting rod, crank shaft, crank case, cam shaft, engine valve, gear wheel, clutch plate, axle, bearings, chassis, spring, body panel and brake lining.

UNIT – V MECHANICAL PROPERTIES AND TESTING [9]

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test – Izod and Charpy, Fatigue and creep tests.

Introduction to nondestructive testing of materials – basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain alloys and phase diagram, iron-iron carbide diagram and steel classification.
CO2: Describe isothermal transformation, continuous cooling diagrams and different heat treatment processes.
CO3: Identify the different polymer, ceramics and composites and their uses in engineering field.
CO4: Recognize and select the suitable materials for various automotive components.
CO5: Summarize the mechanism of plastic deformation and testing mechanical properties.

Text Book :

1 Kenneth G.Budinski and Michael K.Budinski, Engineering Materials: Properties and selection, Prentice-Hall of India Private Limited, Fourth Indian Reprint, 2010.

2 Khanna.O.P, A text book of Materials Science and Metallurgy, Dhanpat Rai Publishing Co Pvt. Ltd, 2010.

Reference Books :

1 Raghavan.V, Materials Science and Engineering, Prentice Hall of India Pvt., Ltd., India, Sixth Edition, 2015.

2 Sydney H.Avner, Introduction to Physical Metallurgy, Tata McGraw Hill Book Company, India, 2017.

3 G.E. Dieter, Mechanical Metallurgy, Tata McGraw-Hill Book Company, India, Third Edition, 2017

4 Williams D Callister, Material Science and Engineering, Wiley India Pvt Ltd, Revised Indian Edition 2014.

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SEMESTER - IV

		L	T	P	C
18AU414	**MECHANICS OF MACHINES**	3	1	0	4

Prerequisite: Fundamentals of Engineering Mechanics

Objectives:

- *To calculate the velocity and acceleration of simple mechanisms.*
- *To comprehend the effect of friction in different machine elements.*
- *To create the cam profile for different follower motions and identify the different gear trains.*
- *To analyse the static and dynamic balancing of various mechanical systems.*
- *To solve the free and forced vibrations for differential applications.*

UNIT – I MECHANISMS [12]

Machine structure – Kinematic link, pair and chain – Gruebler's, KutchBach criteria – Constrained motion – Degrees of freedom – Inversions of four bar, slider crank and crank rocker mechanisms – Applications –Kinematic analysis of simple mechanisms – Determination of velocity and acceleration – slider crank mechanism – four bar mechanism.

UNIT – II FRICTIONAL DEVICES [12]

Friction in screw and nut – Pivot and collar –Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT – III GEARING AND CAMS [12]

Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicylic gear trains – Determination of speed and torque – Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

UNIT – IV BALANCING [12]

Static and dynamic balancing – Single and several masses in different planes – Balancing of reciprocating masses - Primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline and outline).

UNIT – V VIBRATION [12]

Free, forced and damped vibrations of single degree of freedom systems – Force transmitted to supports – Vibration isolation – Vibration absorption – Torsional vibration of shaft – Single and multi-rotor systems – Geared shafts – Critical speed of shaft– Resonance.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the concepts of mechanisms and determine velocities and accelerations of various planar mechanisms.
CO2: Analyze and evaluate the amount of friction involved in various moving components.
CO3: Comprehend profile, geometry and nomenclature of gear and cam, construct various gear trains and cams for different types of motions.
CO4: Apply the concept of balancing in rotating and reciprocating masses under various operating conditions.
CO5: Acquire knowledge on vibrations in different systems and apply different damping methods to minimize vibrations.

Text Book :

1 Rattan.S.S, Theory of Machines, Tata McGraw–Hill Publishing Co., New Delhi, Fourth Edition, 2014.
2 Shigley, J.E. and Uicker, J.J., Theory of Machines and Mechanisms, Tata McGraw-Hill Education, New Delhi, Fourth Edition, 2014.

Reference Books :

1 Ambekar A.G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
2 Rao.S.S., Mechanical Vibrations, Pearson India Education Services Pvt. Ltd., New Delhi, Sixth Edition, 2016.
3 Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, India, Third Edition, 2008.
4 Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall of India, New Delhi, 1979.

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SEMESTER - IV

		L	T	P	C
18AU415	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS**	3	0	0	3

Prerequisite: Basics of Electrical and Electronics Engineering

Objectives:

- *To be familiar with the fundamentals, operating principles of batteries.*
- *To illustrate the functionality of stator motor and charging systems.*
- *To comprehend the concepts of ignition systems*
- *To acquire the knowledge about wiring, lighting and fuel supply systems.*
- *To demonstrate the instruments and sensors used in vehicles.*

UNIT – I TYPES OF BATTERIES [9]

Principle and construction of lead acid battery, Nickel-Cadmium battery, Lithium ion battery, Nickel metal hydride battery, Sodium sulphur battery and Aluminium air battery. Characteristics of battery, battery rating, capacity and efficiency, various tests on battery, Battery – charging techniques, maintenance of batteries.

UNIT – II ELECTRICAL COMPONENTS [9]

Requirements of starter motor, starter motor types, construction and characteristics, starter drive mechanisms, starter switches and solenoids, charging system components, Integrated alternator-starter. Generators and alternators - types, construction and characteristics, voltage and current regulation, charging circuits.

UNIT – III IGNITION SYSTEMS [9]

Components and working of battery coil and magneto–ignition system, electronic ignition system, capacitive discharge ignition system, distributor less ignition system, digital ignition system, direct ignition system, ignition triggering devices, centrifugal and vacuum advance mechanisms. Spark plug – Construction, working and types.

UNIT – IV WIRING, LIGHTING AND FUEL SUPPLY SYSTEMS [9]

Automotive wiring, insulated and earth return system, negative earth systems, head lamp and Indicator lamp details, anti dazzling and dipper details, electrical feed pump, electronic fuel injection systems.

UNIT – V INSTRUMENTS AND SENSORS [9]

Theory and constructional details of dash board instruments and their sensors like Speedometer, odometer, fuel level Indicator, oil pressure and coolant temperature indicators, horns and wiper mechanisms. Introduction to modern driver information systems. Types of sensors – oxygen sensor, hotwire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Demonstrate the working principle, charging techniques and maintenance of batteries.
CO2: Explain about the various basic electrical components of vehicles.
CO3: Describe the various ignition systems used in the vehicles.
CO4: Illustrate the different wiring, lighting and fuel supply systems.
CO5: Identify instruments and sensors for various applications in vehicle control systems.

Text Book :

1 Young, A.P. and Griffith, S.L., Automobile Electrical Equipment, ELBS and New Press, London 1999.
2 Kholi .P.L., Automotive Electrical Equipment, Tata McGraw-Hill co ltd, New Delhi, First Edition, 2004.

Reference Books :

1 Crouse W.H., Automobile Electrical Equipment, Tata McGraw Hill Education, NewYork, 2010.
2 Judge A.W, Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 2004.
3 Robert Bosch, “Automotive Handbook”, Bently Publishers, Cambridge, Ninth Edition, 2014.
4 Tom Denton, Automotive Electrical and Electronic Systems, Routledge, India, Fifth Edition, 2017.

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SEMESTER - IV

		L	T	P	C
18AU416	**AUTOMOTIVE FUELS AND LUBRICANTS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the manufacture of fuels and lubricants.*
- *To infer properties and testing of fuels.*
- *To acquire the knowledge of fuels and alternative fuels for engines with their performance and emission characteristics.*
- *To describe the engine friction and various types of lubrication mechanism.*
- *To explain the need of lubricants, factors influencing the lubricants and testing of lubricants.*

UNIT – I MANUFACTURE OF FUELS AND LUBRICANTS [9]

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

UNIT – II PROPERTIES AND TESTING OF FUELS [9]

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

UNIT – III FUELS FOR I.C. ENGINES [9]

Types of fuels, liquid and gaseous fuels, volatility characteristics, desirable characteristics of SI engine fuels, alternate fuels for SI engines. CI engine fuels, desirable characteristics, alternative fuels for CI engines, Alcohol, biodiesel, hydrogen, natural gas, Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LPG).

UNIT – IV THEORY OF LUBRICATION [9]

Engine friction: Effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system.

UNIT – V LUBRICANTS [9]

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

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the manufacturing processes of fuels and lubricants.
CO2: Evaluate the properties and testing of fuels.
CO3: Identify the fuels and alternative fuels for engines with their performance and emission characteristics.
CO4: Discuss the engine friction and various types of lubrication mechanism.
CO5: Examine the need of lubricants, factors influencing the lubricants and testing of lubricants.

Text Book :

1 Ganesan. V, Internal Combustion Engines, Tata McGraw Hill Education, New Delhi, Fourth Edition, 2012.
2 Mathur M.L. and Sharma R.P, A Course in Internal Combustion Engines, Dhanpat Rai and sons, New Delhi, 2014.

Reference Books :

1 Roger F. Haycock and John E. Hiller, Automotive Lubricants Reference Book, SAE International, 2004.
2 Brame J.S.S. and King J.G, Fuels Solids, Liquids, Gaseous, Edward Arnold, London,1961.
3 Lansdown A.R, Lubrication: A practical guide to lubricant selection, Pergamon press,1982, ISBN: 9780080267272
4 Paul Richards, Automotive fuels reference book, SAE International, Third Edition, 2014.

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SEMESTER – IV

		L	T	P	C
18AU421	**AUTOMOTIVE FUELS AND LUBRICANTS LABORATORY**	0	0	3	1

Prerequisite: -

Objectives:

- *To acquire the knowledge on international and national standards, rating of fuels and lubricants.*
- *To explain the distillation test, flash and fire point test of fuels.*
- *To infer the aniline point, cloud and pour point and viscosity testing of fuels.*
- *To determine the Reid vapour pressure, calorific value of fuel and corrosion test of fuels*
- *To examine the drop point and penetration test of grease.*

List of Experiments:

1. Study of International and national standards for fuels and lubricants.
2. Study of octane and cetane number of fuels.
3. Determination of flash and fire point test of fuels.
4. ASTM distillation test of liquid fuels.
5. Determination of aniline point test of diesel.
6. Determination of viscosity of lubricants and fuels by Redwood viscometer.
7. Determination of viscosity index of lubricants and fuels by Saybolt viscometer.
8. Determination of Reid vapour pressure of fuels.
9. Determination of cloud and pour point of fuels.
10. Determination of calorific value of liquid / gaseous fuel.
11. Copper strip corrosion test.
12. Determination of drop point of grease and mechanical penetration in grease.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the international and national standards, rating of fuels and lubricants.
CO2: Acquire knowledge in the area of testing of fuels and lubricants using flash and fire point, viscosity apparatus.
CO3: Recognize the procedures for evaluating the calorific value and ASTM distillation test of fuels.
CO4: Evaluate the reid vapour pressure, aniline point, pour point, cloud point and copper corrosion tests of fuels.
CO5: Measure and compare hardness of the lubricants through drop point and penetration test.

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SEMESTER - IV

		L	T	P	C
18AU422	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS LABORATORY**	0	0	3	1

Prerequisite: Basic Electrical and Electronics Engineering

Objectives:

- *To explain the testing batteries and battery maintenance, testing of starting motors and alternator.*
- *To acquire the knowledge on electrical wiring in automobiles and simulation of electrical circuits.*
- *To gain the knowledge on fault diagnosis of ignition systems.*
- *To explain the uses of rectifiers, flip-flops and SCR in automotive systems.*
- *To describe the interfacing DAC for control application, A/D converter for simple data acquisition.*

List of Experiments:

a) Electrical Laboratory

1. Testing of batteries and battery maintenance.
2. Testing of starting motors.
3. Testing of alternator
4. Diagnosis of ignition system faults
5. Study of automobile electrical wiring.
6. Simulation of electrical circuits.

b) Electronics Laboratory

1. Study of Half wave and Full wave rectifiers
2. Study of flip-flops
3. Study of SCR
4. Interfacing DAC for control application
5. Interfacing A/D converter for simple data acquisition

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Acquire knowledge in the area of testing of batteries, starting motors and alternator.
CO2: Recognize the different wiring diagrams used in automotive and simulation of electrical circuits.
CO3: Examine the faults in ignition systems
CO4: Identify the suitable rectifiers, flip-flops, SCR to use automotive systems.
CO5: Evaluate the interfacing DAC for control application, A/D converter for simple data acquisition.

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SEMESTER - IV

		L	T	P	C
18AU423	**AUTOMOTIVE CHASSIS AND ENGINE COMPONENTS LABORATORY**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To assemble and dismantle the parts of an IC engines.*
- *To identify the various components of an IC engines.*
- *To identify the various components in transmission systems of an automobile.*
- *To assemble and dismantle the various components of transmission systems.*
- *To study all the functions of automobile components.*

List of Experiments:

1. Dismantling and study of multi-cylinder petrol engine.
2. Assembling and study of multi-cylinder petrol engine.
3. Dismantling and study of multi-cylinder diesel engine.
4. Assembling and study of multi-cylinder diesel engine.
5. Study of petrol and diesel engine fuel system.
6. Study and measurement of light and heavy commercial vehicle frame.
7. Study, dismantling and assembling of front and rear axles.
8. Study, dismantling and assembling of differential and clutch, drive shaft.
9. Study, dismantling and assembling of gear boxes.
10. Study of steering system.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Dismantle and assemble the automobile components.
CO2: Recognize the different fuel systems.
CO3: Acquire the knowledge of various vehicle frames and components of engines.
CO4: Examine the working of differential, clutch and drive shaft.
CO5: Describe the working principle of steering system and gear boxes of automotive systems.

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SEMESTER - IV

		L	T	P	C
18HR412	**CAREER DEVELOPMENT SKILLS - II**	0	2	0	0

Prerequisite: *-*

Objectives:

- *To make students strong on verbal and logical reasoning*
- *To strengthen students on number system*
- *To develop students on logarithms*
- *Critically interpret and comprehend a given text.*
- *To strengthen students on quick maths.*

UNIT – I VERBAL AND LOGICAL REASONING – PART 1 [6]

Alphabet Test – Synonyms & Antonyms – Idioms & Phrases – Analogies - Theme Detection – Odd Words – Statement & Conclusions - Family Tree – Blood Relations – Coding & Decoding – Syllogism – Odd Man Out.

UNIT – II QUANTITATIVE APTITUDE – PART 1 [6]

Numbers : Number system - Squaring of Numbers – Square Roots – Cube Roots – Divisibility – HCF , LCM – Decimals.

UNIT – III QUANTITATIVE APTITUDE – PART 2 [6]

Percentages – Averages – Ratio & Proportion – Mixtures and Allegations – logarithms.

UNIT – IV READING COMPREHENSION&WRITTEN COMMUNICATION –PART 3 [6]

READING SKILLS : Importance of Reading – Definition of Reading – Levels of Reading – Requirements of Reading – Types of Reading – Techniques of Reading - Academic Reading Tips.

What is Writing – Sentence – Phrase – Kinds of Sentences – Parts of Sentence – Parts of Speech – Articles – Academic Essay Writing – Precise Writing – Report Abstracts – Letter Writing – Memo – Cover Letter – Resume Writing.

UNIT – V QUANTITATIVE APTITUDE – PART 3 [6]

Profit and Loss – Simple Interest & Compound Interest – Problem on Ages – Calendar.

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Speak and write appropriately by understanding and applying the basic grammatical rules.

CO2: Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.

CO3: Enhance their communication skills and instructiveness.

CO4: Enhance interpersonal relationship building skills with self – confidence.

CO5: Critically evaluate various real life situation by resorting to analysis of key issues and factors.

Text Book:

1. Anne Laws, Writing Skills, Orient Black Swan., Hyderabad, 2011.
2. Abhijit Guha, Quantitative Aptitude, TMH, Third Edition,2009.

Reference Books :

1 Agarwal. R.S, A.Modern Approach to Verbal and Non- verbal Reasoning, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2 Sarah Freeman, Written Communication in English, Orient Black Swan, Hyderabad, First Edition, 2015.
3 M.B. Lal & Goswami, Objective Instant Arithmetic, Upkar Publications, First Edition, 2010.
4 Norman Lewis, Word Power Made Easy, W.R.Goyal Publications, Reprint, 2012.
5 M Ashra Rizvi, Effective Technical Communication, Tata McGraw HILL, New Delhi, First Edition, 2005

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SEMESTER - V

		L	T	P	C
18AU511	**AUTOMOTIVE TRANSMISSION**	3	0	0	3

Prerequisite: *Automotive Chassis and Automotive Engines*

Objectives:

- *To compare the types and principle of clutches.*
- *To describe the construction and working principle of gear boxes.*
- *To infer the principle of hydrodynamic drives.*
- *To demonstrate the various hydrostatic and electric drives.*
- *To list out the applications of automatic transmission.*

UNIT – I CLUTCH [9]

Requirement of transmission system, Different types of clutches, principle & construction of single plate coil spring and diaphragm spring clutches, multi-plate clutch, Centrifugal Clutch, Electromagnetic Clutch and dual clutch. Friction lining materials.

UNIT – II GEAR BOXES [9]

Need and objectives of gear box. Construction and operation of sliding mesh, constant mesh and synchromesh gear boxes. Transfer box. Principle and operations of planetary gear box. Power and economy modes in gear box, Gear box maintenance.

UNIT – III HYDRODYNAMIC DRIVE [9]

Fluid coupling – Principle of operation, constructional details, torque capacity, performance characteristics and reduction of drag torque. Hydrodynamic torque converter – Principle of operation, constructional details and performance characteristics. Multistage torque converters and poly phase torque converters.

UNIT – IV HYDROSTATIC AND ELECTRIC DRIVE [9]

Hydrostatic drive, Various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitation. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical Janny hydrostatic drive. Electric drive – types – Electric Drive Train Topologies, Principle of early and modified Ward Leonard Control system – Advantages and limitations.

UNIT – V AUTOMATIC TRANSMISSION APPLICATIONS [9]

Need for manual, Intelligent manual, automatic, automated manual transmission, principle of operation. Hydraulic control system for automatic transmission. Turboglide transmission, Continuously variable transmission (CVT) – Types – Operations.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the purpose of transmission system and types of clutches.
CO2: Analyze the principle of gear box, engine power and maintenance.
CO3: Summarize the working principle of hydrodynamic drives.
CO4: Categorize the various types of hydrostatic drives and electric drives.
CO5: Examine the various application of automatic transmission in automobile industry.

Text Book :

1 Kirpal Singh, "Automotive Engineering, Vol. I", Standard Publishers and Distributors pvt. Ltd, New Dlehi, Thirteenth Edition, 2012.

2 Harald Naunheimer , Bernd Bertsche ,Joachim Ryborz , Wolfgang Novak, Automotive Transmissions, Springer, Berlin, Heidelberg, Second Edition, 2011

Reference Books :

1 Crouse W.H., Anglin D.L , Automotive Transmission and Power Trains Construction, Tata McGraw Hill Education US, 1976.

2 Ramalingam K.K, Automobile Engineering, Scitech Publications (India) Pvt. Ltd., Chennai, Second Edition, 2011.

3 Heinz Heisler, Advance Vehicle Technology, Butterworth-Heinemann, London, Second Edition, 2002.

4 Garrett . T.K., Newton. K, Steeds. W, Motor Vehicle, Butterworth-Heinemann, London, Thirteenth Edition, 2000.

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SEMESTER - V

		L	T	P	C
18AU512	**DESIGN OF MACHINE ELEMENTS**				
	(Use of Standard and approved Design Data Book is permitted)	3	1	0	4

Prerequisite: *Mechanics of Materials*

Objectives:

- *To familiarize the various steps involved in the design processes and design the machine members subjected to static and variable loads.*
- *To design the shafts and couplings for various applications.*
- *To analyze the bolted and welded joints for various kinds of loads.*
- *To design the helical, leaf springs and flywheels for various applications.*
- *To design the sliding and rolling contact bearings.*

UNIT – I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS [12]

Introduction to the design process – Four C's of design - factor influencing machine design, selection of materials based on mechanical properties – Preferred numbers, limits, fits and tolerances – Direct, Bending and Torsional stress equations – Calculation of principal stresses for various load combinations – eccentric loading - Factor of safety - Theories of failure – Stress concentration – Design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT – II DESIGN OF SHAFTS AND COUPLINGS [12]

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid flange and flexible couplings – Muff, clamp, rigid flange and bushed – pin flexible couplings.

UNIT – III DESIGN OF TEMPORARY AND PERMANENT JOINTS [12]

Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints – Axially loaded unsymmetrical welded joints – Eccentric load in the plane of welds – Welded joints subjected to bending and twisting moment – Design of riveted joints.

UNIT – IV DESIGN OF SPRINGS AND FLYWHEEL [12]

Design of helical, multi- leaf and torsional springs under constant loads and varying loads – End conditions and length of springs - Stresses in Helical springs of circular wire – Wahl's stress factor – Concentric torsion springs – Design of flywheels involving stresses in rim and arm.

UNIT – V DESIGN OF BEARINGS [12]

Design of bearings – Sliding contact and rolling contact types – Cubic mean load – Design of journal bearings – Mckees equation – Lubrication in journal bearings – Calculation of bearing dimensions – Fundamentals of fracture mechanics.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Examine the influence of steady and variable stresses in machine components.
CO2: Select the suitable shaft and coupling for a particular application.
CO3: Identify the basic design concepts of temporary and permanent joints.
CO4: Find and identify suitable springs and understand the design concepts of flywheels.
CO5: Acquire knowledge on bearings for engineering applications.

Text Book :

1 Bhandari.V, Design of Machine Elements, Tata McGraw–Hill Publishing Co., New Delhi, Fourth Edition, 2016.
2 Shigley, J.E., Mischke. C.R., Mechanical Engineering Design, Tata McGraw-Hill Education, New York, Tenth Edition, 2015.

Reference Books :

1 Sundararajamoorthy T.V., Shanmugam. N., Machine Design, Anuradha Publications, Chennai, 2018.
2 Gope. P.C., Machine Design - Fundamental and Application, PHI learning Pvt. Ltd., New Delhi, 2012.
3 Juvinall. R.C., Marshek. K.M., Fundamentals of Machine Component Design, John Wiley & Sons, New Delhi, Seventh Edition, 2019.
4 Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s. Kalaikathir Achchagam, Coimbatore, 2019.

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SEMESTER - V

		L	T	P	C
18AU513	**VEHICLE DESIGN AND DATA CHARACTERISTICS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To familiarize the various variables involved in the vehicle design procedure.*
- *To calculate the rolling resistances at various speeds and power requirement for different loads.*
- *To describe the torque, pressure – volume diagram and friction mean effective pressure calculations.*
- *To summarize the calculations of piston velocity and acceleration against crank angle, gas force, turning moment and side thrust against crank angle.*
- *To determine the gear ratios, gradability and vehicle performance.*

UNIT – I INTRODUCTION [9]

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

UNIT – II RESISTANCE TO VEHICLE MOTION [9]

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

UNIT – III PERFORMANCE CURVES – I [9]

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

UNIT – IV PERFORMANCE CURVES – II [9]

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

UNIT – V GEAR RATIOS [9]

Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the various variables involved in vehicle design procedure.
CO2: Evaluate the rolling resistances, driving force and power requirement for different loads and acceleration.
CO3: Summarize the various vehicle performance parameters and design parameters.
CO4: Recognize the plotting of piston velocity and acceleration against crank angle, turning moment and side thrust against crank angle.
CO5: Identify the various gear ratios on vehicle performance.

Text Book :

1 Giri. N.K., Automotive Mechanics, Khanna Publishers New Delhi, New Delhi, 2014.
2 Heldt. P.M., High Speed Combustion Engines, Oxford and I.B.H. Publishing Co., Kolkata, 2002.

Reference Books :

1 Gupta. R.B., Automobile Engineering, Sathya Prakashan, New Delhi, First Edition, 2016.
2 Lichty , IC engine, Kogakusha Co. Ltd., Tokyo, 1991.

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SEMESTER - V

		L	T	P	C
18AU514	**AUTOMOTIVE COMPUTER CONTROLLED SYSTEMS**	3	0	0	3

Prerequisite: *Basics of Electrical and Electronics Engineering*

Objectives:

- *To acquire the fundamental concepts of automotive electronics.*
- *To infer the digital electronics and micro-processors and its applications for automotive control.*
- *To summarize the various components and operation of automotive computer controlled systems.*
- *To describe the common automotive technology and engine related systems.*
- *To explain the self diagnosis and diagnostic tools for automotive systems.*

UNIT – I AUTOMOTIVE ELECTRONICS [9]

Basics of semiconductors, Diodes, Rectifiers and transistors relevant to automotive electronics – Amplifiers – Feedback and control – Piezo electric effect – LCD's.

UNIT – II DIGITAL ELECTRONICS AND MICROPROCESSORS [9]

Binary number system – AND, OR, NOT, NAND, NOR circuits-Boolean algebra – Exclusive OR gate – Flip flop devices – A/D and D/A conversion – Block diagram of microcomputer-Architecture and Basic concepts of 8085 – Pin configuration – Instruction set – Simple programs using arithmetic and logical operations – Micro controllers.

UNIT – III COMPUTER ECM [9]

The fundamental parts of an ECM and its functions – Practical automotive computer controlled system – Principles of operation – Computer data, Interfaces and memories – Control of output devices – Fault codes – Adaptive operating strategy – Networking of computers – Vehicle network systems.

UNIT – IV COMMON AUTOMOTIVE TECHNOLOGY [9]

Common automotive technology and engine related systems – Ignition system – Computer controlled fuelling system for petrol engines – Computer controlled diesel engine management systems – Computer controlled fuelling system for diesel engines.

UNIT – V SELF DIAGNOSIS AND DIAGNOSTIC TOOLS [9]

Access to diagnostic trouble codes – Developments in self-diagnosis – Circuit testing – Vehicle specific details – Six step approach – Emission testing – Intermittent faults – OBD – SRS – Coded Ignition key – Fault tracing.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the basic concepts of automotive electronics.
CO2: Recognize the function and application of microprocessors.
CO3: Examine various components and operation of automotive computer controlled systems.
CO4: Describe the functions of various computer controlled engine management system.
CO5: Categorize the different faults and diagnostic tools.

Text Book :

1 Allan Bonnick., Automotive Computer Controlled systems, Butterworth- Heinemann, London, 2001.
2 Ramesh Gaonkar, Microprocessor Architecture, programming and Applications with 8085", Penram International Publishing India Pvt. Ltd., Mumbai, Sixth Edition, 2013.

Reference Books :

1. Tom Denton, Advanced Automotive fault diagnosis, Routledge (an imprint of Taylor & Francis Group), New York, Fourth Edition, 2016.
2. Robert Bosch, Automotive Microelectronics, Bentley Publishers, US, 2002.
3. Dougles V. Hall, Microprocessor and interfacing: Programming and Hardware, Tata McGraw Hill Education, New Delhi, 1999.
4. Mathur M.L. and Sharma R.P, A Course in Internal Combustion Engines, Dhanpat Rai and sons, New Delhi, 2014.

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SEMESTER - V

		L	T	P	C
18MC053	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**	3	0	0	0

Prerequisite: -

Objectives:

- *To describe the basic principles of thought process, reasoning and inferencing.*
- *To focus the sustainability, core of Indian Traditional Knowledge Systems connecting society and nature.*
- *To summarize the basic principles of Yoga and holistic health care system.*
- *To examine the Indian philosophical tradition.*
- *To infer the Indian linguistic tradition and artistic tradition.*

UNIT – I BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM [9]

Basic structure of Indian knowledge system

UNIT – II MODERN SCIENCE AND INDIAN KNOWLEDGE SYSTEM [9]

Modern science and Indian knowledge system

UNIT – III YOGA AND HOLISTIC HEALTH CARE [9]

Yoga and holistic health care

UNIT – IV CASE STUDIES [9]

Philosophical Tradition

UNIT – V INDIAN TRADITION [9]

Indian Linguistic Tradition, Phonology, morphology, syntax and semantics, Indian Artistic Tradition

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the connect up of Indian traditional knowledge
CO2: Explain basics of Indian traditional knowledge in modern scientific perspective.
CO3: Recognize the contribution of Indian mind in various fields.
CO4: Develop positive attitude toward Indian thoughts and traditions
CO5: Examine the Indian linguistic tradition and artistic tradition.

Reference Books :

1. Sivaramakrishna. V (Ed.). Cultural Heritage of India – Course Material, Bharatiya Vidya Bhavan, Mumbai, Fifth Edition, 2014.
2. Swami Jitatmanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan.
3. Fritz of Capra, “Tao of Physics”
4. Fritz of Capra, “The wave of Life”
5. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
6. Jha. R.N., “Science of Consciousness Psychotherapy and Yoga Practices”, Vidyanidhi Prakasham, New Delhi, 2016.
7. Sharma. P.R. (English Translation), “Shodashang Hridayam”.

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SEMESTER - V

		L	T	P	C
18AU521	**AUTOMOTIVE COMPONENTS DESIGN AND MODELING LABORATORY**	0	0	3	1

Prerequisite: *Computer Aided Drawing Laboratory*

Objectives:

- *To familiarize the fundamental concepts of modeling the piston and connecting rod.*
- *To apply the basic design knowledge for design the crank shaft and flywheel.*
- *To construct the valve assembly and combustion chamber using modeling software.*
- *To design and create the model of cam shaft assembly and clutch plate assembly using modeling software.*
- *To construct the propeller shaft assembly and final drive using modeling software.*

List of Experiments:

1. Modeling of piston, piston pin and piston rings.
2. Modeling of connecting rod small end and big end, Shank, big end cap, bolts.
3. Modeling of centre and side crank shaft.
4. Modeling of flywheel.
5. Modeling of the inlet and exhaust valve assembly.
6. Modeling of combustion chamber.
7. Modeling of cam shaft assembly.
8. Modeling of clutch plate assembly.
9. Modeling of propeller shaft assembly.
10. Modeling of final drive.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Acquire the modeling of piston, connecting rod and its components.
CO2: Recognize the modeling of crankshaft and flywheel.
CO3: Construct the model of valve assembly and combustion chamber.
CO4: Develop the model of camshaft and clutch assembly using modeling software.
CO5: Create the model of propeller shaft and final drive using modeling software.

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SEMESTER - V

		L	T	P	C
18AU522	**AUTOMOTIVE ELECTRONICS AND MICROPROCESSOR LABORATORY**	0	0	3	1

Prerequisite: *Engineering Practices Laboratory*

Objectives:

- *To perform the testing of PN junction diode and Zener diode.*
- *To study the logic gates, half adder, full adder and operational amplifier.*
- *To describe the different microprocessor programming such as addition, subtraction.*
- *To summarize the different microprocessor programming such as multiplication, division and sorting.*
- *To demonstrate the stepper motor interfacing programming.*

List of Experiments:

ELECTRONICS

1. VI characteristics of PN junction diode and Zener diode.
2. Characteristics of JFET.
3. Study of logic gates (Basic gates).
4. Half adder and Full adder.
5. Operational amplifier (Inverting and non - inverting)

MICROPROCESSORS

1. Block transfer.
2. 8 bit addition, subtraction.
3. Multiplication and division.
4. Sorting.
5. Stepping motor interfacing.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the performance characteristics of PN junction diode and Zener diode.
CO2: Recognize the logic gates, half adder, full adder and operational amplifier.
CO3: Demonstrate basic concepts of microprocessor programming of 8 bit addition, subtraction, and block transfer.
CO4: Examine the different microprocessor programming such as multiplication, division and sorting.
CO5: Create programming to interface the stepper motor.

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SEMESTER - V

		L	T	P	C
18AU523	**ENGINE PERFORMANCE AND EMISSION TESTING LABORATORY**	0	0	3	1

Prerequisite: *Automotive Engines, Engineering Thermodynamics and Heat Transfer*

Objectives:

- *To acquire the basic knowledge of different dynamometers, valve timing diagram, port timing diagram and emission analysis of IC engines.*
- *To conduct the performance and emission test on multi-cylinder CI and SI engines and two wheeler SI engine.*
- *To conduct the retardation test on IC engines.*
- *To conduct the heat balance and Morse test on multi-cylinder petrol and diesel engines.*
- *To construct the* P-θ and P-V diagrams.

List of Experiments:

1. Study of hydraulic, electrical and eddy current dynamometers.
2. Study of emission analysis of I.C. Engines.
3. Valve timing and port timing diagrams.
4. Performance and emission test on two wheeler SI engine.
5. Performance test on automotive multi-cylinder SI / CI engine.
6. Emission test on automotive multi-cylinder SI / CI engine.
7. Retardation test on I.C. Engines.
8. Heat balance test on automotive multi-cylinder SI / CI engine.
9. Morse test on multi-cylinder SI engine.
10. Engine cylinder pressure measurement P-θ and P-V diagrams for IC engine with piezo-electric pick up, charge amplifier, angle encoder and data acquisition system.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Perform tests using different dynamometers, valve and port timing diagram and analysis the engine emissions.
CO2: Experiments with the performance and emission test on multi-cylinder CI and SI engines and two wheeler SI engine.
CO3: Interpret the retardation test on IC engines.
CO4: Perform the heat balance and Morse test on multi-cylinder petrol and diesel engines.
CO5: Plot the P-θ and P-V diagrams using data acquisition system.

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SEMESTER - V

		L	T	P	C
18HR513	**CAREER DEVELOPMENT SKILLS – III**	0	2	0	0

Prerequisite: *-*

Objectives:

- *To enhance the writing and speaking skills through continuous practices.*
- *To sharpen the verbal and logical reasoning through skillful conceptualization.*
- *To improve the learning skills of students in aptitude*
- *To learn the problem solving skill and to improve thinking capability of the students.*
- *To study the various concept in core subjects.*

UNIT – I WRITTEN AND ORAL COMMUNICATION – PART 1 [6]

Reading Comprehension Level 3 – Self Introduction – News Paper Review – Self Marketing – Debate – Structured and Unstructured GDs Psychometric Assessment – Types & Strategies to answer the questions Practices: Sentence Completion – Sentence Correction – Jumbled Sentences – Synonyms & Antonyms – Using the Same Word as Different Parts of Speech – Interpretation of Pictorial Representations – Editing.

UNIT – II VERBAL & LOGICAL REASONING – PART 2 [6]

Syllogism – Assertion and Reasons – Statements and Assumptions – Identifying Valid Inferences – identifying Strong Arguments and Weak Arguments – Statements and Conclusions – Cause and Effect – Deriving Conclusions from Passages – Seating Arrangements Practices: Analogies – Blood Relations – Statement & Conclusions.

UNIT – III QUANTITATIVE APTITUDE – PART 3 [6]

Probability – Calendar – Clocks – Logarithms – Permutations and Combinations

UNIT – IV QUANTITATIVE APTITUDE – PART 4 [6]

Algebra – Linear Equations – Quadratic Equations – Polynomials – Problem on Numbers – Ages – Train – Time and Work – Sudoku – Puzzles

UNIT – V DEPARTMENT TECHNICAL TOPICS [6]

Competitive exam training: Fluid Mechanics and Hydraulic Machines – Engineering Thermodynamics and Heat Transfer – Automotive chassis and engines – Mechanics of Machines – Automotive Fuels and Lubricants – Material Science and Metallurgy.

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand the nearness of leading various texts.
CO2: Perform well in verbal and logical reasoning.
CO3: Understand and develop the etiquette necessary to present oneself in a professional setting.
CO4: Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
CO5: Enhance the comprehension Skills in core subjects.

Text Book :

1. Anne Laws, Writing Skills, Orient Black Swan, Hyderabad, 2011.
2. Abhijt Guha, Quantitative Aptitude, TMH, Third Edition, New Delhi, 2009.

Reference Books :

1 M Ashra Rizvi, Effective Technical Communication, Tata McGraw HILL, New Delhi, First Edition, 2005.
2 Sarah Freeman, Written Communication in English, Orient Black Swan, Hyderabad, First Edition, 2015.
3 M.B. Lal & Goswami, Objective Instant Arithmetic, Upkar Publications, First Edition, 2010.
4 Norman Lewis, Word Power Made Easy, W.R.Goyal Publications, Reprint, 2012.
5 Jain R.K., Mechanical Engineering for Competitions, Khanna Publishers, New Delhi, Seventh Edition, 2015.

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SEMESTER - VI

		L	T	P	C
18AU611	**AUTOMOTIVE CHASSIS COMPONENTS DESIGN** (Use of Standard and approved Design Data Book is permitted)	3	1	0	4

Prerequisite: *-*

Objectives:

- *To broaden the importance of clutch types and brake design procedure.*
- *To describe the gear box design and types of gear boxes.*
- *To introduce vehicle frames and structures along with its design elements and suspension systems*
- *To infer the components of steering systems and front axle systems*
- *To acquire the knowledge in driveline and final drives systems.*

UNIT – I CLUTCH AND BRAKE DESIGN [12]

Design of single plate clutch, multi plate clutch, design of centrifugal clutch, cone clutch, energy dissipated, torque capacity of clutch, design of clutch components, design details of roller and sprag type of clutches, brake design.

UNIT – II GEAR BOX [12]

Design considerations of gearbox, selection of proper gear ratios for an automobile gearbox, calculation of gear ratio, design of three, five and seven speed gear boxes.

UNIT – III VEHICLE FRAME AND SUSPENSION [12]

Study of loads, moments and stresses on frame members, design of frame for passenger and commercial vehicles, design of leaf springs, coil springs and torsion bar springs, design of air suspension, Damper

UNIT – IV FRONT AXLE AND STEERING SYSTEMS [12]

Design of front axle beam, analysis of loads, moments and stresses at different sections of front axle, determination of bearing loads at kingpin bearings, wheel spindle bearings, choice of bearings, determination of optimum dimensions and proportions for steering linkages ensuring minimum error in steering.

UNIT – V FINAL DRIVE AND REAR AXLE [12]

Design of propeller shaft, design details of final drive gearing, design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and differential design, Constant velocity joint design.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the suitable clutch and braking systems based load conditions.

CO2: Examine the gear box design and types of gear boxes.

CO3: Recognize the design of vehicle frame and suspension systems used in automobiles.

CO4: Interpret the design procedures of front axle and steering systems.

CO5: Acquire knowledge on design concept of final drive and rear axles.

Text Book :

1 Giri.N.K, Automotive Mechanics, Khanna Publisher, New Delhi, 2014.

2 Heldt.P.M, Automotive Chassis, Chilton Co., New York, 1992.

Reference Books :

1 Steeds. W, Mechanics of Road Vehicles, Illife Books Ltd., London, 1990.

2 Giles.K.G , Steering, Suspension and tyres, Ilife Books Ltd., London, 1988.

3 Dean Averns, Automobile Chassis Design, Illife Books Ltd, London, 2001.

4 Garrett . T.K., Newton. K, Steeds. W, Motor Vehicle, Butterworth-Heinemann, London, Thirteenth Edition, 2000.

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SEMESTER - VI

		L	T	P	C
18AU612	**AUTOMOTIVE ENGINE COMPONENTS DESIGN**				
	(Use of Standard and approved Design Data Book is permitted)	3	1	0	4

Prerequisite: *-*

Objectives:

- *To familiarize the automotive engine component materials and its properties.*
- *To infer the design concepts of cylinder and piston.*
- *To describe the design procedure of connecting rod.*
- *To develop the design concepts of crank shaft and cam shaft, balancing of masses.*
- *To acquire the knowledge on valve and flywheel design.*

UNIT – I INTRODUCTION [12]

Engineering material and their physical properties applied to design, selection of materials, factor of safety, endurance limit, notch sensitivity, principles of design optimization, future trends, computer aided drafting. Definitions, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness.

UNIT – II DESIGN OF CYLINDER AND PISTON [12]

Choice of material for cylinder and piston, piston friction, piston slap, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly.

UNIT – III DESIGN OF CONNECTING ROD [12]

Material for connecting rod, determining minimum length of connecting rod, small end and big end design, shank design, design of big end cap bolts, connecting rod failures.

UNIT – IV DESIGN OF CRANKSHAFT AND CAM SHAFT [12]

Balancing of I.C. engines, significance of firing order, material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, cam shaft and cam design

UNIT – V DESIGN OF VALVES AND FLYWHEEL [12]

Design aspects of intake and exhaust manifolds, inlet and exhaust valves, valve springs, tappets, valve train. Materials and design of flywheel.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the various types of engineering materials and selection of materials.
CO2: Analysis the design concepts of cylinder and piston.
CO3: Identify the optimal design solutions of connecting rod.
CO4: Interface the concept of design of crank shafts and cam shaft
CO5: Examine the design procedure of valves and flywheel for automotive applications.

Text Book :

1 Shigley, J.E., Mischke. C.R., Mechanical Engineering Design, Tata McGraw-Hill Education, India, Tenth Edition, 2015..
2 Jain,R.K., Machine Design, Khanna Publishers, New Delhi, 2005.

Reference Books :

1 Sundararajamoorthy T.V., Shanmugam. N., Machine Design, Anuradha Publications, Chennai, 2018.
2 Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s. Kalaikathir Achchagam, Coimbatore, 2019.
3 Hall Allen,S. & Others, Machine Design, Schaum's series, Tata McGraw–Hill Publishing Co., New Delhi, 1982.
4 Bhandari.V, Design of Machine Elements, Tata McGraw–Hill Publishing Co., New Delhi, Fourth Edition, 2016.

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SEMESTER - VI

		L	T	P	C
18AU613	**TRANSPORT MANAGEMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To familiarize the concept of personal management objectives and functions.*
- *To acquire the knowledge on various transport systems and their advantages.*
- *To describe the scheduling and fare structure.*
- *To describe the Motor Vehicle Act.*
- *To summarize the various activities of preventive maintenance system.*

UNIT – I INTRODUCTION [9]

Personnel management, objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure and psychological tests.

UNIT – II TRANSPORT SYSTEMS [9]

Introduction to various transport systems. Advantages of motor transport, principal function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility forms of ownership by state, municipality, public body and private undertakings.

UNIT – III SCHEDULING AND FARE STRUCTURE [9]

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

UNIT – IV MOTOR VEHICLE ACT [9]

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle – tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time and test for competence to drive, Insurance act in motor vehicle, contemporary issues, Smart RC card.

UNIT – V MAINTENANCE [9]

Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear, remedies, maintenance procedure for better fuel economy and Design of bus depot layout.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Outline the concept of personnel management objectives and functions.
CO2: Explain the various transport systems and their advantages.
CO3: Categorize the scheduling and fare structure.
CO4: Explain the need and requirement of documentation and certification.
CO5: Acquire knowledge on various activities of preventive maintenance system.

Text Book :

1 John E. Dolce, Analytical Fleet Maintenance Management, SAE International, New York, Third Edition, 2009.
2 Kitchin.L.D., Bus Operation, Illiffee and Sons Co., London, Third edition, 1992.

Reference Books :

1 Government Motor Vehicle Act, Publication on latest act to be used as on date.
2 Ejaz Ahemed, The motor vehicle Act 1939, Ashok law house, India, 1989.
3 John Duke., Fleet Management, Tata McGraw Hill Co., New York, 1994.

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SEMESTER - VI

		L	T	P	C
18AU621	**VEHICLE COMPONENTS DESIGN AND ANALYSIS LABORATORY**	0	0	3	1

Prerequisite: *Automotive Components Design and Modeling Laboratory*

Objectives:

- *To acquire the knowledge on modeling software to analyze the chassis frame and connecting rod, piston.*
- *To apply the design concepts to analyze the aero foil profile housing and leaf spring.*
- *To examine the composite structure and brake disc analysis with help of modeling software.*
- *To make the assembly and simulation of four bar mechanism, cam and follower.*
- *To find the faults by means of simulation analysis.*

List of Experiments:

1. Static structure analysis of chassis frame.
2. Transient analysis of connecting rod.
3. Thermal analysis of piston.
4. Modal analysis of aero foil profile housing.
5. Stress analysis of leaf spring.
6. Stress analysis of composite structure.
7. Couple field analysis of brake disc.
8. Simulation of four bar mechanism.
9. Simulation of cam and follower.
10. Crash test simulation analysis.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Examine the analysis concepts behind the chassis frame, connecting rod and piston.
CO2: Evaluate the modal analysis of aerofoil profile housing and leaf spring.
CO3: Analyze the stress analysis of composite structure and filed analysis of brake disc.
CO4: Identify the simulation procedures of four bar mechanism, cam and follower.
CO5: Forecast the faults by means of crash test simulation analysis of a four wheeler.

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SEMESTER - VI

		L	T	P	C
18AU622	**COMPUTER AIDED MANUFACTURING LABORATORY**	0	0	3	1

Prerequisite: *Automotive Components Design and Modeling Laboratory*

Objectives:

- *To study about the G and M code for various CNC operations.*
- *To program the part programming for turning, facing, chamfering, taper turning, profile turning in CNC lathe.*
- *To create the part programming for thread cutting, grooving, drilling and boring, canned cycle.*
- *To develop the part programming for contour milling, peck drilling.*
- *To prepare the part programming using mirroring, rectangular pocketing.*

List of Experiments:

1. Study about G and M Code for various CNC operations

Part programming (Using G and M Codes) in CNC lathe

2. Part programming for turning, facing and chamfering.
3. Part programming using canned cycle.
4. Part programming for taper turning and profile turning.
5. Part programming for thread cutting and grooving.
6. Part programming for drilling and boring.

Part programming (Using G and M Codes) in CNC milling

7. Part programming for contour milling.
8. Part programming using mirroring.
9. Part programming for peck drilling.
10. Part programming using rectangular pocketing.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the G and M code for various CNC operations and to develop part programming using canned cycle.
CO2: Generate the part programming for turning, facing, chamfering, taper turning, profile turning in CNC lathe.
CO3: Prepare the part programming for thread cutting, grooving, drilling and boring, canned cycle.
CO4: Construct the part programming for contour milling, peck drilling.
CO5: Create the part programming using mirroring, rectangular pocketing.

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SEMESTER - VI

		L	T	P	C
18AU623	**SUMMER INTERNSHIP**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To gain the knowledge of fast and rapid changing automotive technology by self learning.*
- *To acquire on job skills, knowledge, attitudes, and perceptions along with the experience needed to constitute a professional identify.*
- *To give an insight into the working of the real organizations.*
- *To develop perspective about business organizations in their totality.*
- *To get deeper understanding in specific functional areas.*

Guidelines:

1. The students have to undergo practical industrial training for two weeks in recognized industrial establishments during their vacation periods.
2. At the end of the training they have to submit a report with following information:
    i. Profile of Industry
    ii. Product range
    iii. Organization structure
    iv. Plant layout
    v. Processes / Machines / Equipment / Devices
    vi. Details of the training undergone
    vii. Learning points
3. The student will prepare a presentation individually about the industrial training for 15 minutes duration.
4. The assessments will be based equally on the report in the prescribed format and viva-voice examination by a committee nominated by the Head of the Department.

Total : 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recollect and appreciate the basics of automobile and mechanical engineering concepts by self learning.
CO2: Gain knowledge about the present industrial scenarios.
CO3: Prepare a presentation on an emerging technology chosen in the proper format.
CO4: Acquire knowledge on the technical topic chosen in the proper format
CO5: Effectively communicate the contents to the target audience and handle questions with confidence.

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SEMESTER - VI

		L	T	P	C
18HR614	**CAREER DEVELOPMENT SKILLS – IV**	0	2	0	0

Prerequisite: *-*

Objectives:

- *To assist individuals in making appropriate educational and occupational choices.*
- *To discuss the importance of using effective action words, keywords.*
- *To prepare a resume, describe how to showcase one's professional skill sets in a cover letter, and perform these tasks.*
- *To enhance the business etiquettes and ethics.*
- *To learn the different concepts in core subjects.*

UNIT – I WORLD OF TEAMS [6]

Self Enhancement – Importance of developing assertive skills – developing self-confidence – developing emotional intelligence, Importance of Teamwork – Team Vs Group – Attributes of a Successful team – Barriers involved, Working with groups – Dealing with people – Group Decision Making

UNIT – II INTERVIEW, GD AND PRESENTATION SKILLS [6]

Interview handling skills – self preparation checklist – Grooming tips: do's and don'ts – mock interview & feedback, GD Skills – understanding the objective and skills tested in a GD – General types of GD – Roles in a GD – do's and don'ts – Mock GD & Feedback – Practice.

UNIT – III RESUME WRITING [6]

An Introduction to the Resume – Types of Resumes – The Chronological Resume – The Functional Resume – The Combination Resume – Curricula Vitae - Preparing to Write Your Resume – Common Resume Errors – Presentation – Professional Objective and Education Section – Experience / Fresher – Skills Section – Honors and Awards – Activities and Interests – Polishing Your Resume – Cover Letters.

UNIT – IV BUSINESS ETIQUETTE AND ETHICS [6]

Grooming Etiquette – Telephone & Email Etiquette – Dining Etiquette – do's and don'ts in formal setting – How to Impress

Ethics – Importance of ethics and Value – choice and dilemmas faced – Discussion form news headlines.

UNIT – V DEPARTMENT TECHNICAL TOPICS [6]

Competitive exam training: Automotive Transmission – Design of Machine Elements – Automotive chassis and engines Design – Automotive Computer Controlled Systems – Material Science and Metallurgy.

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Enhance the team spirit and work in a effectively.
CO2: Perform well in HR interview.
CO3: Tailor their own resume according to job needs.
CO4: Comprehend business etiquette and work globally.
CO5: Perform well in competitive exam training.

Text Books :

1 Dr.R.S.Aggarwal, Quantitative Aptitude, S. Chand & Company Limited, New Delhi, Sixteenth Edition, 2018.
2 Dr.R.S.Aggarwal, A Modern Approach to Verbal & Non -Verbal Reasoning, S. Chand & Company Limited, New Delhi, Fourth Edition,2015.

Reference Books :

1 M Ashra Rizvi, Effective Technical Communication, Tata McGraw HILL, New Delhi, First Edition, 2005
2 Abhijit Guha, Quantitative Aptitude, TMH, New Delhi, Third Edition,2016.
3 M.B. Lal, Goswami, Objective Instant Arithmetic,Upkar Publications, Delhi, Second Edition,2012.
4 W.R.Norman Lewis, Word Power Made Easy, Goyal Publications, New Delhi, Fourth Edition,2016.
5 Jain R.K., Mechanical Engineering for Competitions, Khanna Publishers, New Delhi, Seventh Edition, 2015.

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SEMESTER – VII

		L	T	P	C
18HS051	**PROFESSIONAL ETHICS** (Common To All Branches)	3	0	0	3

Prerequisite: *-*

Objectives:

- *To gain the knowledge of basic perception of ethics, moral and values*
- *To know the current Industrial standards*
- *To know the risk and safety benefit in industry*
- *To Discuss the rights and responsibility of an engineers*
- *To Acquire Knowledge in global issues and able to apply in ethical principles in professional life.*

UNIT – I ENGINEERING ETHICS [9]

Senses of 'engineering ethics' – Variety of moral issued – Types of inquiry - Moral dilemmas – Moral autonomy – Kohlberg's theory – Gilligan's theory – Consensus and controversy – Models of professional roles – Professional ideals and virtues – Uses of ethical theories.

UNIT – II ENGINEERING AS SOCIAL EXPERIMENTATION [9]

Engineering as experimentation – Engineers as responsible experimenters – Codes of ethics – Industrial standards – Balanced outlook on law – The challenger case study.

UNIT – III ENGINEER'S RESPONSIBILITY FOR SAFETY [9]

Safety and risk – Assessment of safety and risk – Risk benefit analysis – Reducing risk – Liability – The Chernobyl and Bhopal case studies.

UNIT – IV RESPONSIBILITIES AND RIGHTS [9]

Collegiality and loyalty – 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 – Corporate Social Responsibility(CSR) – Moral Leadership – Code of Conduct.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the basic perceptions of ethics, moral and values.
CO2: Describe the current industrial standards
CO3: Discuss the risk and safety benefits in the industry
CO4: Explain the professional rights and responsibilities of an engineers
CO5: Illustrate the Various global issues and apply the ethical principles in professional life..

Text Book :

1 Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw-Hill, New Delhi, Fifth Edition, 2017.
2 Dr.K.R.Govindan and S.Senthilkumar, Professional Ethics, Anuradha Agencies, Chennai, Revised Edition, 2014.

Reference Books :

1 Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, Fourth Edition, New Delhi, 2016.
2 Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, Seventh Edition, 2015
3 Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Thompson Learning, Sixth Edition, 2015.
4 A.B Rao "Business Ethics & Professional Values" – Excel books, Fifth Edition 2014.

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SEMESTER – VII

		L	T	P	C
18AU712	**VEHICLE DYNAMICS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To acquire the knowledge about the vibration and responses.*
- *To use dynamic analysis in the design of vehicles.*
- *To comprehend the ride properties of the vehicle.*
- *To acquire the knowledge on the importance of tire and its dynamics*
- *To describe the vehicle stability techniques of the vehicles.*

UNIT – I CONCEPT OF VIBRATION [9]

Definitions, modeling and simulation, global and vehicle coordinate system, free, forced, undamped and damped vibration, response analysis of single DOF, two DOF, multi DOF, magnification factor, transmissibility, vibration absorber, vibration measuring instruments, torsional vibration and critical speed.

UNIT – II PERFORMANCE MODE [9]

Acceleration – free body diagram of accelerating vehicle, maximum transferable tractive force, gradability, deceleration – maximum decelerating rates, stopping distance, maximum braking force, straight line motion – aerodynamic forces and moments, viscosity effects – separation and its control – aerodynamic lift and its control – ground effect – profile for minimum drag.

UNIT – III RIDE MODE [9]

Effects of damping the vibration, vibration absorbers, pitch and bounce motion, oscillation centers – active and semi active suspension – Orthogonality of mode shapes, modal analysis and vehicle performance testing.

UNIT – IV HANDLING MODE [9]

Tyres – mechanics, testing and modeling, vehicle control – low speed cornering and static steering – Ackerman steering geometry, steady–state cornering – steering factors, vehicle control parameters (under steer, neutral steer and over steer),steady state handling – lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed – effect of braking on vehicle handling – constant radius testing.

UNIT – V VEHICLE STABILITY [9]

Load distribution. Calculation of tractive effort and reactions for different drives – front wheel drive, rear wheel drive, four wheel drive, multi-axle drive – stability of a vehicle on a slope, on a curve and a banked road. Mimuro Plot for lateral transient response.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Develop physical and mathematical models to predict the dynamic response of vehicles.
CO2: Summarize the dynamic analysis in the design of vehicles.
CO3: Determine the reaction forces induced in the vehicles.
CO4: Recognize the proper tires for better performance of vehicle on all the road surfaces.
CO5: Analyze the stability of vehicle.

Text Book :

1 Gillespie T.D, Fundamentals of Vehicle Dynamics, SAE International, New York, 2014.
2 Giri. N.K., Automotive Mechanics, Khanna Publishers, New Delhi, Eighth Edition, 2008.

Reference Books :

1 Rajesh Rajamani, Vehicle Dynamics and Control, Springer, Boston, Second Edition, 2012.
2 Georg Rill, Road Vehicle Dynamics: Fundamentals and Modeling, CRC Press, New York, 2011.
3 Singiresu S.Rao, Mechanical Vibrations, Prentice Hall, New Delhi, Fifth Edition, 2010.
4 Dean Karnopp, Vehicle Dynamics, Stability, and Control, CRC Press, New York, 2013.

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SEMESTER - VII

		L	T	P	C
18AU713	**VEHICLE MAINTENANCE AND TESTING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To familiarize the need and procedures of service records used for vehicle maintenance.*
- *To acquire the knowledge on engine maintenance.*
- *To summarize the maintenance of fuel system, cooling systems, lubrication system and vehicle body.*
- *To describe the maintenance activities of electrical and electronic system.*
- *To infer the maintenance and testing procedures of major components of vehicle.*

UNIT – I MAINTENANCE OF RECORDS AND SCHEDULES [9]

Requirements and importance of maintenance, types of maintenance, preparation of check lists, Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance. Motor vehicle acts, insurance etc and traffic rules, motor vehicle driving rules and regulation.

UNIT – II ENGINE MAINTENANCE – REPAIR AND OVERHAULING [9]

Dismantling of engine components and cleaning, cleaning methods, visual and dimensional inspections, minor and major reconditioning of various components, reconditioning methods, engine assembly, special tools used for maintenance overhauling, engine tune up and including modern engines.

UNIT – III MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VECHICLE BODY [9]

Servicing and maintenance of fuel system of different types of vehicles, calibration and tuning of engine for optimum fuel supply. Cooling systems, water pump, radiator, thermostat, anticorrosion and antifreeze additives. Lubrication maintenance, lubricating oil changing, greasing of parts. Vehicle body maintenance, minor and major repairs. Door locks and window glass actuating system maintenance.

UNIT – IV ELECTRICAL AND ELECTRONIC SYSTEM MAINTENANCE – SERVICING AND REPAIRS [9]

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

UNIT – V MAINTENANCE AND TESTING OF MAJOR COMPONENTS OF VEHICLE [9]

Maintenance and servicing of suspension systems, steering systems, overhauling and maintenance. Wheel alignment, computerized alignment and wheel balancing.

Vehicle performance testing: Laboratory testing – Testing of major components of vehicle like clutch, suspension, braking, steering etc., Vehicle testing on chassis dynamometers, Road and track testing, Initial inspection, running in and durability, extensive driving, maximum speed, acceleration and ride comfort.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Examine the procedures of service records used for vehicle maintenance.
CO2: Describe the maintenance activities of the engines and overhauling procedures.
CO3: Identify the service procedure of fuel system, cooling systems, lubrication system and vehicle body.
CO4: Evaluate the maintenance activities of electrical and electronic systems.
CO5: Discuss the maintenance and testing of various subsystems of vehicle.

Text Book :

1 John E. Dolce, Analytical Fleet Maintenance Management, SAE International, New York, Third Edition, 2009.
2 James D. Halderman, Advanced Engine Performance Diagnosis, Pearson Education, New Delhi, Seventh Edition, 2019.

Reference Books :

1 Ken Layne, Engine performance diagnosis and tune-up, by H.M. Gousha Company, Canfield Press, New York, 1978.
2 John Duke., Fleet Management, Tata McGraw Hill Co., New York, 1994.
3 Service Manuals from different vehicle manufacturers.
4 Judge. A.N, Motor vehicle engine servicing, Pitman Paper pack, London, Third Edition, 1969.

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SEMESTER - VII

		L	T	P	C
18AU721	**VEHICLE MAINTENANCE AND RECONDITIONING LABORATORY**	0	0	3	1

Prerequisite: *-*

Objectives:

- *To provide knowledge about vehicle maintenance and reconditioning.*
- *To acquire skills in handling situations where the vehicle is likely to fail.*
- *To comprehend various types of maintenance of vehicles, features and applications.*
- *To apply the knowledge in servicing vehicle components.*
- *To analyze the fault in modern engine using engine analyzer.*

List of Experiments:

Vehicle maintenance laboratory

1. Study and layout of automobile repair, service and maintenance shop.
2. Study and list of tools and instruments.
3. Minor and major tuning of diesel and petrol engines.
4. Removal of tyre and tube
5. Adjustment of head light beam.
6. Wheel alignment.
7. Wheel balancing.

Re-Conditioning Laboratory

8. Cylinder reboring – checking the cylinder
9. Valve grinding, valve lapping, valve clearance setting and seating of valve
10. Reconditioning of fuel injection pump and nozzle Sorting.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Examine the layout of service and maintenance shop and services procedures.
CO2: Describe the minor and major tuning of diesel and petrol engines, adjustment of head light beam procedure.
CO3: Perform the wheel alignment and balancing procedures, tyre removal procedures.
CO4: Evaluate the procedures of cylinder reboring, valve grinding, valve lapping and valve clearance setting.
CO5: Define the procedures of reconditioning of fuel injection pump and nozzle sorting.

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SEMESTER - VII

		L	T	P	C
18AU722	**PROJECT – I**	0	0	6	3

Prerequisite: *-*

Objectives:

- *To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.*
- *To prepare the project reports and to face reviews and viva voce examination.*
- *To identify practical problems and find a solution related to automotive and relative domains.*
- *To demonstrate their report writing and presentation skills.*
- *To comprehend the project management practices.*

Guidelines:

1. The project work in Phase – I and II may contain a theoretical study and analysis, experimental analysis, design, modeling & simulation, fabrication of a model or a prototype or a combination of the above related to automotive area.
2. The project work may include literature review, modeling, analysis, simulation, fabrication, testing and analysis & correlation of test data etc.
3. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member.
4. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
5. In Phase-I of the project, literature survey, projects task plan and design phases should have been completed
6. A project report is required at the end of the semester.
7. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify a practical problems related to automotive industry.
CO2: Solve the problems with related to feasible solution.
CO3: Recognize the project management techniques.
CO4: Comprehend the industrial scenarios.
CO5: Demonstrate their report writing and presentation skills.

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SEMESTER – VIII

		L	T	P	C
18AU811	**ELECTRIC AND HYBRID VEHICLES**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub system design and hybrid vehicle control.*
- *To acquire the knowledge on subsystems of hybrid and electric vehicles.*
- *To design the required energy storage devices.*
- *To select the suitable electric propulsion systems.*
- *To infer the design consideration for electric vehicles.*

UNIT – I NEED FOR ALTERNATIVE SYSTEM [9]

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT – II SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES [9]

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Steering and Suspension system. Choice of Tires.

UNIT – III ENERGY SOURCES [9]

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride – Lithium ion- Sodium based- Metal Air. Battery Modeling- Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT – IV MOTORS AND CONTROLLERS [9]

Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT – V DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES [9]

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems, performance of electrical vehicles.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Summarize the electric and hybrid vehicle operation and architectures.

CO2: Design and develop the systems of electric and hybrid vehicles.

CO3: Demonstrate the energy requirement for vehicles.

CO4: Identify the vehicle characteristics, operating modes, and performance parameters of the vehicle.

CO5: Explain the different subsystems of electric and hybrid vehicles.

Text Book :

1 Iqbal Husain, Electric and Hybrid Vehicles-Design Fundamentals, CRC Press, New York, Second Edition, 2010.

2 Mehrdad Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles, CRC Press, New York, Second Edition, 2009.

Reference Books :

1 James Larminie and John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons, New York, Second Edition, 2012.

2 Lino Guzzella, Vehicle Propulsion System, Springer, Berlin, Heidelberg, 2013

3 Ron HodKinson, Light Weight Electric/ Hybrid Vehicle Design, Butterworth Heinemann Publication, 2001

4 Ronald K Jurgen, Electric and Hybrid – Electric Vehicles, SAE International, New York, 2011.

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SEMESTER - VIII

		L	T	P	C
18AU821	**PROJECT – II**	0	0	12	6

Prerequisite: -

Objectives:

- *To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.*
- *To prepare the project reports and to face reviews and viva voce examination.*
- *To identify practical problems and find a solution related to automotive and relative domains.*
- *To demonstrate their report writing and presentation skills.*
- *To comprehend the project management practices.*

Guidelines:

1. To continue the Phase – I project and executing the same in consultation with the project coordinator and project guide
2. A detailed analysis/modelling/simulation/design/problem solving/experiment is a must to complete and an effort leading to paper publication or patenting is desired.
3. A working model or prototype is to be submitted for end semester evaluation
4. A project report is required to be submitted at the end of the semester in the required format.
5. Project work done at Industry should be duly supported by certificate from the Industry.
6. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
7. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify a practical problems related to automotive industry.
CO2: Solve the problems with related to feasible solution.
CO3: Recognize the project management techniques.
CO4: Comprehend the industrial scenarios.
CO5: Demonstrate their report writing and presentation skills.

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU661	**AUTOMOTIVE AIR-CONDITIONING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the fundamentals of the automotive air-conditioning system.*
- *To describe the basic of vehicle air-conditioning system, its components, working principle and control mechanism.*
- *To infer the air-conditioning controls, delivery system and refrigerants.*
- *To summarize the different types of sensors and actuators used in automatic temperature control.*
- *To provide adequate knowledge in safe working practice, correct procedures for A/C service and repair.*

UNIT – I AUTOMOTIVE AIR-CONDITIONING FUNDAMENTALS [9]

Purposes of heating, ventilation and air conditioning – Environmental concerns – Ozone layer depletion – Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychrometry – basic terminology and psychrometric mixtures – Psychrometric chart- Related problems.

UNIT – II AUTOMOTIVE COOLING AND HEATING SYSTEM [9]

Vehicle refrigeration system and related problems – Fixed thermostatic and orifice tube system – Variable displacement thermostatic and orifice tube system – Vehicle air conditioning operation – Types of compressor – Compressor clutches – compressor clutch electrical circuit – Compressor lubrication – condensers – Evaporators – expansion devices – Evaporator temperature and pressure controls – receiver - Drier – Accumulators- Refrigerant hoses, Connections and other assemblies – Heating system.

UNIT – III AIR-CONDITIOING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS [9]

Types of Control devices – Preventing Compressor damage – Preventing damage to other systems – Maintaining drive ability- Preventing Overheating – Ram air ventilation – Air delivery Components – Control devices – Vacuum Controls Containers – Handling refrigerants – Discharging, Charging and Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

UNIT – IV AUTOMATIC TEMPERATURE CONTROL [9]

Different types of sensors and actuators used in automatic temperature control – Fixed and variable displacement temperature control – Semi Automatic – Controller design for fixed and variable displacement type air conditioning system.

UNIT – V SYSTEM SERVICING AND TESTING [9]

Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems – Diagnosing cooling system – Air delivery system – Automatic temperature control system diagnosis and service.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Illustrate the components of the automotive air-conditioning and their fundamentals.
CO2: Describe the working principles of the components of the automotive air-conditioning systems.
CO3: Examine the air-conditioning controls, delivery system and refrigerants.
CO4: Identify the current developments related to automotive air-conditioning like automatic temperature control.
CO5: Infer the air-conditioning system services and testing.

Text Book :

1 Warren Farnell and James D.Halderman, Automotive Heating, Ventilation, and Air Conditioning systems, Pearson Prentice Hall, New Delhi, Third Edition, 2004

2 William H Crouse and Donald L Anglin, Automotive Air conditioning, Tata McGraw Hill Education Pvt. Ltd., New York 1990.

Reference Books :

1 Mitchell Information Services, Inc., Mitchell Automatic Heating and Air Conditioning Systems, Prentice Hall Inc., Auburn, 1989.

2 Paul Weisler, Automotive Air Conditioning, Reston Publishing Company, New York, 1990.

3 McDonald,K.L., Automotive Air Conditioning, Theodore Audel Company, Chicago, 1978.

4 Goings,L.F., Automotive Air Conditioning, American Technical services, New York, 1974

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU662	**ALTERNATIVE FUELS AND ENERGY SYSTEMS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To develop knowledge on the possible way of using alcohols as a fuel in IC engines.*
- *To find the challenges and difficulties in using vegetable oil as an alternative fuel in IC engines.*
- *To identify the uses of hydrogen as fuel in IC engines as an alternative for fossil fuels.*
- *To discuss the usefulness of natural acquiring gases towards IC engines.*
- *To summarize the layouts and configuration of electric, hybrid and fuel cell vehicles.*

UNIT – I ALCOHOLS AS FUELS [9]

Introduction to alternative fuels – Need for alternative fuels – Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT – II VEGETABLE OILS AS FUELS [9]

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating, transesterification and emulsification of vegetable oils – Performance in engines – Performance, emission and combustion characteristics in diesel engines.

UNIT – III HYDROGEN AS ENGINE FUEL [9]

Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage – Safety aspects of hydrogen.

UNIT – IV BIOGAS, NATURAL GAS AND LPG AS FUELS [9]

Production methods of biogas, natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas, Modification required to use in SI and CI Engines – Performance and emission characteristics of biogas, NG and LPG in SI and CI engines.

UNIT – V ELECTRIC, HYBRID AND FUEL CELL VEHICLES [9]

Layout of electric vehicle and hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, electronic control system – Different configurations of hybrid vehicles. Power split device. High energy and power density batteries – Basics of fuel cell vehicles.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Justify the possible ways of using alcohols as a fuel in the IC engines.
CO2: Infer the challenges and difficulties in using vegetable oil as an alternative fuel in IC engines.
CO3: Identify the uses of hydrogen as fuel in SI and CI engines as an alternative for fossil fuels.
CO4: Relate the usefulness of biogas, natural gas and LPG as fuels in SI and CI engines.
CO5: Identify the layouts and different configurations of electric, hybrid and fuel cell vehicles.

Text Book :

1 Ayhan Demirbas, Biodiesel A Realistic Fuel Alternative for Diesel Engines, Springer-Verlag London Limited 2008, ISBN-13: 9781846289941.
2 Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997, ISBN 0-76-80-0052-1.

Reference Books :

1 Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois, 2005.
2 Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).
3 Science direct Journals (Biomass & Bio energy, Fuels, Energy, Energy conversion Management, Hydrogen Energy, etc.) on biofuels.
4 Ganesan. V, Internal Combustion Engines, Tata McGraw-Hill Publishing Co., New Delhi, Fourth Edition, 2012.

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU663	**VIRTUAL INSTRUMENTATION IN AUTOMOBILE ENGINEERING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To familiarize the block diagram and architecture of virtual instrumentation.*
- *To describe the components and its functions of data acquisition*
- *To infer the communication networked modules.*
- *To discuss the real time control in virtual instrumentation*
- *To summarize the automotive applications.*

UNIT – I INTRODUCTION [9]

Virtual Instrumentation – Definition and flexibility – Block diagram and Architecture of virtual instrumentation – Virtual instruments versus traditional Instruments – Review of software in virtual instrumentation – VI programming techniques – VI, sub VI, Loops and charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, string and File Input / Output.

UNIT – II DATA ACQUISITION IN VI [9]

A/D and D/A Converters, plug-in Analog input / Output cards – Digital Input and output cards, Organization of the DAQ VI system – Isolation – Performing analog input and analog output – Scanning multiple analog channels- issues involved in selection of data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input – Timers and counters.

UNIT – III COMMUNICATION NETWORKED MODULES [9]

Introduction to PC buses – Local buses – ISA,PCI,RS232,RS422 and RS 485 – Interface buses:- USB,PCMCIA,VXI,SCXI and PXI – Instrumentation Buses:- Modbus and GPIB – Networked buses – ISO/OSI reference model, Ethernet and TCP/IP Protocols.

UNIT – IV REAL TIME CONTROL IN VI [9]

Design of ON/OFF controller and proportional controller for a mathematically described processes using VI software – Modeling and basic control of level and reactor processes – Case Studies on development of HMI, SCADA in VI.

UNIT – V AUTOMOTIVE APPLICATIONS [9]

PC based digital storage oscilloscope- Sensor technology and signal processing – virtual laboratory – spectrum analyzer – wave form generator – Data visualization and multiple locations:- Distributed monitoring and control – Vision and motion control. Case study related to automotive applications.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the LabVIEW programming and its interfacing.
CO2: Familiar with the data acquisition systems.
CO3: Remember about the communication networked modules.
CO4: Comprehend the real time controller and model using software.
CO5: Identify the automotive applications using LabVIEW programming.

Text Book :

1 Nadovich, C., Synthetic Instruments Concepts and Applications. Elsevier, 2005.
2 Bitter, R., Mohiuddin, T. and Nawricki, M., Labview Advanced programming Techniques, CRC Press, New York, Section Edition, 2007.

Reference Books :

1 Gupta, S. and Gupta J. P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America, New York, Second Edition, 1994
2 Jamal, R. and Picklik, H., Labview-Applications and Solutions, National Instrument Release.
3 Johnson, G. Labview Graphical programming, McGraw-Hill Education, New York,1997
4 Wells, L.K and Travis, J. Labview for Everyone, Prentice Hall, New Jersey, 1997

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU664	**VEHICLE BODY ENGINEERING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To give exposure to body materials and car body design details.*
- *To comprehend the vehicle aerodynamics and tests.*
- *To get well versed in the design and construction of buses.*
- *To acquire knowledge in commercial vehicle body.*
- *To select appropriate body material for automobiles.*

UNIT – I CAR BODY DETAILS [9]

Car body terminology- Types: Hatch back, Sedan, Estate, SUV, MPV, Limousine, convertibles and racing car - Visibility: driver's visibility, test for visibility, Methods of improving visibility and space in cars - Safety: safety design, safety equipment and active & passive safety components.

UNIT – II VEHICLE AERODYNAMICS [9]

Objectives- Various types of forces and moments -Vehicle drag and types-wake-side wind effects-various body optimization techniques for minimum drag-Wind tunnel testing: Advantages, Flow visualization techniques and total airflow management.

UNIT – III BUS BODY DETAILS [9]

Types: Based on distance travelled: mini bus, town, mofussil, luxury coach. Based on capacity of the bus: single deck, double deck, Split level and articulated bus. Constructional details: Frame, integral and double skin construction- Bus body terminology, Bus Body Lay Out: Floor height, engine location, entrance and exit location, seating dimensions. - Types of metal section used- Safety aspect of bus body.

UNIT – IV COMMERCIAL VEHICLE DETAILS [9]

Different types of commercial vehicle bodies - Light commercial vehicle body types- Construction details of flat platform body, Tipper body and Tanker body - Dimensions of driver's seat in relation to controls - driver's cabin design.

UNIT – V BODY MATERIALS, TRIM AND MECHANISMS [9]

Steel sheet, timber, plastics, FRP (Fibre-reinforced plastics), properties of materials – Corrosion - Anticorrosion methods - Selection of paint - Modern painting process in details - Body trim items - Body mechanisms.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Compare and familiar with different aspects of car body and its types.

CO2: Examine the role of various aerodynamic forces and moments and its measuring instruments.

CO3: Demonstrate the vehicle body regulations to build the bus body.

CO4: Discover some new commercial vehicle body and ergonomics designs.

CO5: Identify the various body materials, trim items and paint.

Text Book :

1 Powloski, J., Vehicle Body Engineering, Business Books Ltd., London, 1998.

2 James E Duffy, Body Repair Technology for 4-Wheelers, Cengage Learning, India, 2009

Reference Books :

1 Giles. G.J., Body construction and design, Iliffe Books Butterworth & Co., London, 1991,

2 John Fenton, Vehicle Body layout and analysis, Mechanical Engg Publication Ltd., London, 1992

3 Braithwaite.J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1997.

4 Dieler Anselm., The passenger car body, SAE International, USA, 2000.

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU665	**AUTOMOTIVE AERODYNAMICS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To apply basic principles of aerodynamics for the design of vehicle body.*
- *To analyze the aerodynamics drag force of cars.*
- *To analyze various aerodynamics shapes of car.*
- *To comprehend the effects of dynamics on the various commercial vehicles.*
- *To apply the concept of wind tunnel for aerodynamics design of automobiles.*

UNIT – I INTRODUCTION [9]

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics.

UNIT – II AERODYNAMIC DRAG OF CARS [9]

Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development and low drag profiles.

UNIT – III SHAPE OPTIMIZATION OF CARS [9]

Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square Back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners. Case studies on Modern vehicles.

UNIT – IV VEHICLE HANDLING [9]

The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial Vehicles and racing cars.

UNIT – V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS [9]

Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods. CFD analysis.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Remember about the importance of aerodynamics for automobiles.
CO2: Analyze the aerodynamics drag force of cars
CO3: Analyze various aerodynamic shapes of car.
CO4: Comprehend the effects of dynamics on the various commercial vehicles
CO5: Apply the concept of wind tunnel for aerodynamic design of automobiles.

Text Book :

1 Hucho .W.H., Aerodynamic of Road Vehicles, Butterworth's Co., Ltd., London, 1997.
2 Pope. A., Wind Tunnel Testing, John Wiley & Sons, New York, Second Edition, 1974.

Reference Books :

1 Automotive Aerodynamics: Update SP-706, SAE International, New York, 1987.
2 Vehicle Aerodynamics, SP-1145, SAE International, New York, 1996

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SEMESTER – VI (Professional Elective - I)

		L	T	P	C
18AU666	**DESIGN OF AUTOMOTIVE JIGS, FIXTURES AND PRESS TOOL** (Use of Standard and approved Design Data Book is permitted)	3	0	0	3

Prerequisite: *-*

Objectives:

- *To apply the principle of locating and clamping in jigs and fixtures.*
- *To design the various types of jigs and fixtures for simple components.*
- *To summarize the press working terminologies and elements of cutting dies.*
- *To design various parts of forming dies and draw the standard dimensioned views.*
- *To get exposure on recent trends in tool design, computer aided forming analysis.*

UNIT – I LOCATING AND CLAMPING PRINCIPLES [9]

Objectives of tool design – function and advantages of jigs and fixtures – basic elements – principles of location – locating methods and devices – redundant location – principles of clamping – mechanical actuation – pneumatic and hydraulic actuation standard parts – drill bushes and jig buttons – tolerances and materials used.

UNIT – II JIGS AND FIXTURES [9]

Design and development of jigs and fixtures for given component – types of jigs – post, turnover, channel, latch, box, pot, angular post jigs – indexing jigs – general principles of milling, lathe, boring, broaching and grinding fixtures – assembly, inspection and welding fixtures – modular fixturing systems – quick change fixtures.

UNIT – III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES [9]

Press working terminologies – operations – types of presses – press accessories – computation of press capacity – strip layout – material utilization – shearing action – clearances – press work materials – center of pressure – design of various elements of dies – die block – punch holder, die set, guide plates – stops – strippers – pilots – selection of standard parts – design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT – IV BENDING FORMING AND DRAWING DIES [9]

Difference between bending, forming and drawing – blank development for above operations – types of bending dies – press capacity – spring back – knockouts – direct and indirect – pressure pads – ejectors – variables affecting metal flow in drawing operations – draw die inserts – draw beads - Ironing – design and development of bending, forming, drawing reverse re-drawing and combination dies – blank development for ax- symmetric, rectangular and elliptic parts – single and double action dies.

UNIT – V MISCELLANEOUS TOPICS [9]

Bulging, swaging, embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine blanking dies – recent trends in tool design – computer aids for sheet metal forming analysis – basic introduction - tooling for numerically controlled machines – setup reduction for work holding – single minute exchange of dies – poka yoke – case study for design of automotive jigs and fixtures.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify with the principles of locating and clamping in jigs and fixtures.

CO2: Analyze the design and development of various types of jigs and fixtures for simple components.

CO3: Describe the press working terminologies and design of various elements of dies.

CO4: Examine the various parts of forming dies and draw the standard dimensioned views.

CO5: Demonstrate the recent trends in tool design, computer aided forming analysis.

Text Book :

1 Joshi, P.H. Jigs and Fixtures, Tata McGraw Hill Publishing Co. Ltd., New Delhi, Third Edition, 2010.

2 Donaldson, Lecain and Goold, Tool Design, Tata McGraw Hill Publishing Co. Ltd., New Delhi, Fourth Edition, 2012.

Reference Books :

1 K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.

2 Joshi, P.H. “Press Tools” – Design and Construction”, S.Chand Publisher, Second Edition, 2010.

3 Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, Fifth Edition, 2004.

4 Faculty of Mechanical Engineering, PSG College of Technology, Design Data Book, M/s. Kalaikathir Achchagam, Coimbatore, 2019.

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SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU761	**ADVANCED THEORY AND SIMULATION OF I.C. ENGINES**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To remember the basics of combustion reactions and its characteristics.*
- *To evaluate about the SI engine simulation and heat release curves.*
- *To study about the CI engine simulation and combustion models.*
- *To identify about the inlet and exhaust process.*
- *To study about the basics of homogeneously charged compression ignition engines.*

UNIT – I THEORY OF COMBUSTION [9]

Combustion reactions and stochiometry, heat of reaction, adiabatic flame temperature in constant pressure and constant volume systems, fuels for internal combustion engines and their properties, premixed and diffusion combustion as applicable to SI and CI engines, concepts of burning rate and flame velocity, fuel spray characteristics and combustion in diesel engines.

UNIT – II SIMULATION OF SI ENGINE COMBUSTION [9]

Engine kinematics, Ideal Otto cycle, SI engine simulation with adiabatic combustion with air as the working substance under full and part throttle conditions. Actual SI engine heat release rate curves. SI engine combustion models using Wiebe‘s function.

UNIT – III SIMULATION OF CI ENGINE COMBUSTION [9]

CI engine simulation with adiabatic combustion with air as the working substance under naturally aspirated, supercharged and turbocharged conditions. Actual heat release rates of diesel engines, Hardenberg and Hase and other ignition delay models for diesel engines, Zero dimensional combustion models for CI engines – Watsons and White House and Way models.

UNIT – IV GAS EXCHANGE PROCESSES [9]

Inlet and exhaust process, Volumetric efficiency, Quasi static effects, flow through valves, residual gas fraction, scavenging in two stroke cycle engines, flow through ports, supercharging and turbo charging – turbo lag.

UNIT – V ADVANCED COMBUSTION ENGINES [9]

Homogeneously charged compressed ignition engines, controlled auto ignition, LHR engines, Surface ignition concept and multi fuel engines, stratified charge and lean burn engines, performance and emission characteristics, merits and demerits.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Remember the basics of combustion reactions and its characteristics.
CO2: Evaluate about the SI engine simulation and heat release curves.
CO3: Examine the CI engine simulation and combustion models.
CO4: Identify about the inlet and exhaust process
CO5: Discuss about the basics of homogeneously charged compression ignition engines.

Text Book :

1 Ashley Campbel, Thermodynamic Analysis of Combustion Engine Processes, Tata Mc Graw Hill Publishing Co., New Delhi, 2006.
2 Ganesan.V. Computer Simulation of compression ignition engine process, Universities Press (I) Ltd, Hyderabad, First Edition, 2000.

Reference Books :

1 Ganesan.V. Computer Simulation of spark ignition engine process, Universities Press (I) Ltd, Hyderabad, Reprint, 2013.
2 Heywood J.B, Internal Combustion Engine Fundamentals, Tata McGraw Hill Education., New York, 2018
3 Ganesan.V, Internal Combustion Engineering, Tata McGraw Hill Publishing Co., New Delhi, Fourth Edition, 2017.
4 Robert Bosch, Automotive Hand book, Eighth Edition, 2011.

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU762	**AUTOMOTIVE VEHICLE SAFETY**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To remember the fundamentals of safety during body design.*
- *To apply the knowledge for selecting the suitable active and passive systems.*
- *To apply the knowledge for selecting the suitable safety equipment for designing a vehicle.*
- *To create the advanced system for increasing the safety in special purpose vehicles.*
- *To familiarize in various systems that enhances vehicle safety, passenger, comfort in automobile etc.*

UNIT – I INTRODUCTION [9]

Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone and safety sandwich construction.

UNIT – II SAFETY CONCEPTS [9]

Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT – III SAFETY EQUIPMENTS [9]

Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags and bumper design for safety.

UNIT – IV COLLISION WARNING AND AVOIDANCE [9]

Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT – V COMFORT AND CONVENIENCE SYSTEM [9]

Steering and mirror adjustment, central locking system , Garage door opening system, tyre pressure control system, rain sensor system and environment information system.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Remember the fundamentals of safety during body design.
CO2: Apply the knowledge for selecting the suitable active and passive systems.
CO3: Apply the knowledge for selecting the suitable safety equipment for designing a vehicle.
CO4: Create the advanced system for increasing the safety in special purpose vehicles
CO5: Familiar in various systems that enhances vehicle safety, passenger, comfort in automobile etc.

Text Book :

1 Bosch, Automotive Handbook, SAE International, New York, Eighth Edition, 2011.
2 Vivek D. Bhise, Ergonomics in the automotive design process. CRC Press, New York, 2012.

Reference Books :

1 Jullian Happian Smith, An Introduction to Modern Vehicle Design, SAE International, New York, 2004.
2 Ronald K Jurgen, Automotive Electronics Handbook, Tata McGraw-Hill Inc., New York, Second Edition, 1999.
3 George A. Peters , Barbara J. Peters, Automotive Vehicle Safety, 2002
4 Powloski. J, Vehicle Body Engineering, Business books limited, London, 2008.

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU763	**TWO AND THREE WHEELERS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To remember the various subsystems of two and three wheelers.*
- *To illustrate the functioning of clutch and gear box of two and three wheelers.*
- *To identify the controls on handle bar and suspension system, construction layout, working and types of wheels and braking systems.*
- *To describe the maintenance procedures of various electrical systems*
- *To familiarize with maintenance procedures of engine, cooling system and lubrication system, checking and servicing of dashboard instruments.*

UNIT – I POWER UNIT [9]

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

UNIT – II CHASSIS AND SUB–SYSTEMS [9]

Mainframe and its types, Chassis. Chain drive and shaft drive, Single, multiple plates and centrifugal clutches. Gear box and gear controls. Front and rear suspension systems. Shock absorbers. Panel meters and controls on handle bar.

UNIT – III BRAKES, WHEELS AND TYRES [9]

Drum brakes, Disc brakes, front and rear brake links, layouts. Spoked wheel, cast wheel, disc wheel, disc types. Tyres and tubes-types, alloy wheels.

UNIT – IV TWO WHEELERS [9]

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

UNIT – V THREE WHEELERS [9]

Case study of Indian models. Front mounted engine and rear mounted engine types. Auto rickshaws, pickup van, delivery van and trailer. Maintenance and Fault tracing.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Remember the various subsystems of two and three wheelers.
CO2: Illustrate the functioning of clutch and gear box of two and three wheelers.
CO3: Identify the controls on handle bar and suspension system, construction layout, working and types of wheels and braking systems.
CO4: Describe the maintenance procedures of various electrical systems
CO5: Familiar with maintenance procedures of engine, cooling system and lubrication system, checking and servicing of dashboard instruments.

Text Book :

1 Irving. P. E., Motor Cycle Engineering, Temple Press Book, London, 1992
2 The Cycle Motor Manual, Temple Press Limited, London, 1990

Reference Books :

1 Marshall Cavendish, Encyclopedia of Motor cycling, 20 volumes, New York and London, 1989
2 Ramalingam. K. K., Two Wheelers, Scitech publications, Chennai, 2009
3 Raymond Broad Lambretta, A Practical Guide to maintenance and repair, S.Chand & Co., New Delhi, 1987.
4 Brayant R.V, Vespa, Maintenance and Repair Series, S.Chand & Co., New Delhi, 1986.

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SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU764	**ERGONOMICS AND AESTHETICS IN AUTOMOTIVE DESIGN**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To identify the importance of ergonomics and its role in automobiles.*
- *To illustrate the various development stages of seating design.*
- *To analyze the visual display design principles.*
- *To describe the automotive lighting and effect of vehicle body styles.*
- *To familiarize with automotive exterior design details.*

UNIT – I INTRODUCTION TO AUTOMOTIVE ERGONOMICS [9]

Ergonomics in Vehicle design –Objectives, importance of ergonomics, implementing ergonomics. System engineering model describing the vehicle development process, vehicle evaluation, goal of ergonomics engineers, Ergonomics engineer's responsibilities.

Engineering anthropometry and biomechanics –introduction, use of anthropometry in designing vehicles, applications of biomechanics in vehicle design –basic biomechanical considerations –biomechanical considerations in seat design, other seat design considerations, Seat design considerations related to driver accommodation.

UNIT – II SEATING PACKAGE LAYOUT [9]

Vehicle packaging -sequence in development of vehicle package –advanced vehicle design stage, development of the accepted vehicle concept, Definition of key vehicle dimensions and reference points, Driver package development procedures.

Driver Information Acquisition and Processing -Understanding driver vision considerations, Information processing, Human errors –types of human errors, understanding human errors with the SORE model. Visual capabilities, Applications of information processing for vehicle design.

UNIT – III CONTROLS, DISPLAYS, AND INTERIOR LAYOUTS [9]

Introduction, Controls and displays interface – types of controls and displays, design consideration, issue, and location principles – control design considerations, visual display design considerations, control and display location principles, Methods to evaluate controls and displays.

Field of view from automotive vehicles – Introduction to field of view, types of fields of view, forward field of view evaluations, mirror design issues, methods to measure fields of view. Other visibility issues - light transmissivity, Plane and convex combination mirrors, heavy truck driver issues.

UNIT – IV AUTOMOTIVE LIGHTING AND ENTRY & EXIT FROM AUTOMOTIVE VEHICLES [9]

Introduction – automotive lighting equipment, objectives, Head lamps and signal lamps: purpose and basic ergonomic issues, Head lighting design considerations, signal lighting design considerations, Photometric measurements of lamp outputs, Headlamp evaluation methods, signal lighting evaluation methods. Introduction to entry and exit, Vehicle features and dimensions related to entry and exit, Methods to evaluate entry and exit, effect of vehicle body style on vehicle entry and exit.

UNIT – V AUTOMOTIVE EXTERIOR INTERFACES [9]

Introduction to exterior interfaces, methods and issue to study- standards, design guidelines, and requirements, Biomechanical guidelines for loading and unloading tasks, applications of manual lifting models, methods of observation, communication, and experimentation

Automotive craftsmanship – craftsmanship in vehicle design, importance of craftsmanship, attributes of craftsmanship, measurement methods, Some examples of craftsmanship evaluation studies- craftsmanship of steering wheels.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the importance of ergonomics and its role in automobiles.
CO2: Illustrate the various development stages of seating design.
CO3: Analyze the visual display design principles.
CO4: Describe the automotive lighting and effect of vehicle body styles.
CO5: Familiar with automotive exterior design details

Text Book :

1 Vivek D. Bhise, Ergonomics in the automotive design process. CRC Press, New York, 2012.

2 Pheasant, Stephen T., and Christine M. Haslegrave. Bodyspace: anthropometry, ergonomics, and the design of work. Third Edition, CRC Press, New York, 2006.

Reference Books :

1 Happian-Smith, Julian, ed. An introduction to modern vehicle design. Elsevier, 2001.

2 Green, William Scott, and Patrick W. Jordan, eds. Human factors in product design: current practice and future trends. CRC Press, New York, 2001.

3 Stanton, Neville A., and Mark Young. Guide to Methodology in Ergonomics: Designing for Human Use. CRC Press, New York, 1999.

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SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU765	**RAPID PROTOTYPING TOOLING AND MANUFACTURING**	3	0	0	3

Prerequisite: *Automotive Manufacturing Technology.*

Objectives:

- *To recognize the stages of product development.*
- *To apply the concepts of stereo lithography and direct metal laser sintering processes.*
- *To remember the concepts of fusion deposition modeling and laminated object manufacturing and the machine details.*
- *To analyze the concepts of solid ground curing and 3D printing processes and the machine details*
- *To familiarize in concepts of Rapid Tooling and the medical applications of RPT.*

UNIT – I PRODUCT DEVELOPMENT STAGES [9]

Introduction: Need for time compression in product development, Product development - conceptual design - development - detail design - prototype - tooling.

UNIT – II STEREO LITHOGRAPHY AND DIRECT METAL LASER SINTERING [9]

Classification of RP systems, Stereo lithography systems - Principle - process parameters – process details - machine details, Applications. Direct Metal Laser Sintering (DMLS) system - Principle - process parameters - process details - machine details, Applications. Selective Laser Melting (SLM) – Process – Advantages and Applications.

UNIT – III FUSION DEPOSITION MODELING AND LAMINATED OBJECT MANUFACTURING [9]

Fusion Deposition Modeling - Principle - process parameters - process details - machine details, Applications. Laminated Object Manufacturing - Principle - process parameters - process details - machine details, Applications.

UNIT – IV SOLID GROUND CURING [9]

Solid Ground Curing - Principle - process parameters - process details - machine details, Applications. 3-Dimensional printers - Principle - process parameters - process details – machine details, Applications, and other concept modelers like thermo jet printers, Sander‘s model maker, JP system 5, Object Quadra system.

UNIT – V RAPID TOOLING [9]

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM) - Principle. Introduction to rapid tooling - direct and indirect method, software for RP - STL files, Magics, Mimics. Application of Rapid prototyping in Medical field.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the stages of product development.
CO2: Apply the concepts of stereo lithography and direct metal laser sintering processes.
CO3: Remember the concepts of fusion deposition modeling and laminated object manufacturing and the machine details.
CO4: Analyze the concepts of solid ground curing and 3D printing processes and the machine details
CO5: Familiar in concepts of Rapid Tooling and the medical applications of RPT.

Text Book :

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

Reference Books :

1 Liou L.W. and Liou F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, New York, 2007.
2 Kamrani A.K. and Nasr E.A., Rapid Prototyping: Theory and practice, Springer, London, 2006.
3 Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, New York, 2000.
4 Pham, D.T and Dimov.S.S, Rapid manufacturing, Springer-Verlag, London, 2001.

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SEMESTER – VII (Professional Elective - II)

		L	T	P	C
18AU766	**MANUFACTURING OF AUTOMOTIVE COMPONENTS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To compare and analyse the different casting process*
- *To design various machining process according to the requirement*
- *To analysis of suitable process related to forming*
- *To differentiate the effect of powder metallurgy on selective components*
- *To impart knowledge on recent trends of automotive components*

UNIT – I CASTING [9]

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

UNIT – II MACHINING [9]

Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston.

UNIT – III FORGING AND EXTRUSION PROCESS [9]

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft and transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets. Hydro forming - Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels.

UNIT – IV POWDER METALLURGY AND PROCESSING OF PLASTICS [9]

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics.

UNIT – V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS [9]

Powder injection molding - Production of aluminium MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming –Squeeze Casting of pistons - aluminium composite brake rotors. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts – Three Dimensional Printing – Process – Benefits and Limitations.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the methods to manufacture the vehicle components
CO2: Analyze the requirements of each component and material
CO3: Differentiate between the casting and forming process
CO4: Design the process for manufacturing vehicle components
CO5: Remember the advanced techniques used for manufacturing Automobile components.

Text Book :

1 Heldt. P.M., High Speed Combustion Engines, Oxford Publishing Co., New York, 1990.
2 Serope Kalpakjian, Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson Education, New Delhi, Fourth Edition, 2003,

Reference Books :

1 Philip F. Ostwald, Jairo Munuz, Manufacturing Processes and Systems, John Wiley & Sons, New York, 1998.
2 Gupta K.M. Automobile Engineering, Vol.I & II, Umesh Publishers, New Delhi, 2000.
3 Kirpal Singh, Automobile Engineering, Vol. I & II, Standard Publishers, New Delhi, 1997.
4 Degarmo E.P., Materials and process in Manufacturing, Macmillan Publishing Co., Stuttgart, 1997.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU767	**COMBUSTION THERMODYNAMICS AND HEAT TRANSFER**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To remember the principle of combustion in thermodynamics.*
- *To identify the kinetics behind the chemical reaction of combustion of fuels.*
- *To progress an idea to understand the properties of flame inside a combustion chamber.*
- *To recognize the principle of conduction, convection and radiation in IC engines.*
- *To perceive the concept of cylinder pressure measurement.*

UNIT – I THERMODYNAMICS OF COMBUSTION [9]

Premixed and diffusion combustion process in IC engines. First and Second Law of Thermodynamics applied to combustion- combustion Stoichiometry- chemical equilibrium, spray formation and droplet combustion.

UNIT – II CHEMICAL KINETICS OF COMBUSTION [9]

Fundamentals of combustion kinetics, rate of reaction, equation of Arrhenius, activation energy. Chemical thermodynamic model for Normal Combustion.

UNIT – III FLAMES [9]

Laminar premixed – flame speed correlations- quenching, flammability, and ignition, flame stabilization, laminar diffusion flames, turbulent premixed flames - Reynolds and Damkohler numbers and their significance.

UNIT – IV HEAT TRANSFER IN IC ENGINES [9]

Engine Heat transfer and heat Balance. Measurement of Instantaneous heat transfer rate. Heat transfer modelling. Heat transfer coefficients, radiative heat transfer.

UNIT – V EXPERIMENTS IN IC ENGINES [9]

Cylinder pressure measurement. Rate of heat release calculation – hot wire and laser Doppler anemometry and velocimetry for flow and combustion analysis in IC engines.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the principle of combustion in thermodynamics.
CO2: Identify the kinetics behind the chemical reaction of combustion of fuels.
CO3: Discuss about the properties of flame inside a combustion chamber.
CO4: Realize the principle of conduction, convection and radiation in IC engines.
CO5: Comprehend the concept of cylinder pressure measurement.

Text Book :

1 Heywood J.B, Internal Combustion Engine Fundamentals, Tata McGraw Hill Publishing Co., New York, 2018.
2 Ashley Campbel, Thermodynamic Analysis of Combustion Engine Processes, Tata McGraw Hill Publishing Co., New Delhi, 2006

Reference Books :

1 Ganesan, V, Internal Combustion Engines, Tata McGraw-Hill Publishing Co., New Delhi, Fourth Edition, 2012.
2 Spalding.D.B., Some fundamental of Combustion, Butterworth Science Publications, London, 1985.
3 Taylor. E.F. The Internal Combustion Engines, International Text Book Co., Pennsylvania, 1982.
4 Irvin Glasman, Combustion, Academic Press, London, 1987, ISBN 0-12-285851-4.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU768	**AUTOMOTIVE POLLUTION AND CONTROL**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To discuss the harmful effects of major pollutants on living beings and the environment*
- *To analyse the formation of major pollutants like UBHC, CO, NOx, particulate matter and smoke.*
- *To design various control techniques to reduce pollutants in combustion*
- *To determine the various after treatment process to minimize emissions*
- *To demonstrate the various devices used to measure pollutants and discuss the Emission standards followed in various nations*

UNIT – I EMISSION FROM AUTOMOBILES [9]

Sources of Pollution. Various emissions from Automobiles – Formation – Effects of pollutants on environment human beings. Emission control techniques – Emission standards.

UNIT – II EMISSION FROM SPARK IGNITION ENGINE AND ITS CONTROL [9]

Emission formation in SI Engines – Carbon monoxide- Unburned hydrocarbon, NOx, Smoke – Effects of design and operating variables on emission formation – controlling of pollutants -Catalytic converters – Charcoal Canister – Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT – III EMISSION FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL [9]

Formation of White, Blue, and Black Smokes, NOx, soot, sulphur particulate and Intermediate Compounds – Physical and Chemical delay – Significance Effect of Operating variables on Emission formation – Fumigation, EGR, HCCI, Particulate Traps, SCR – Cetane number Effect.

UNIT – IV NOISE POLLUTION FROM AUTOMOBILES [9]

Sources of Noise – Engine Noise, Transmission Noise, vehicle structural Noise, aerodynamics noise, Exhaust Noise. Noise reduction in Automobiles – Encapsulation technique for noise reduction – Silencer Design.

UNIT – V TEST PROCEDURES AND EMISSION MEASUREMENTS [9]

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures – Chassis dyno - Seven mode and thirteen mode cycles for Emission Sampling – Sampling problems – Emission analysers – NDIR, FID, Chemiluminesecent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Differentiate the various emissions formed in IC engines
CO2: Analyze the effects of pollution on human health and environment
CO3: Design the control techniques for minimizing emissions
CO4: Categorize the emission norms
CO5: Identify suitable methods to reduce the noise emissions.

Text Book :

1 B.P Pundir , Engine Emissions, Narosa publications, New Delhi, Second Edition, 2017.
2 D.J.Patterson and N.A.Henin, Emission from Combustion Engine and their control, Anna Arbor Science Publication, Washington, 1985.

Reference Books :

1 Crouse and Anglin, Automotive Emission Control, Tata McGraw Hill company, New York, 1993.
2 C.Duerson, Noise Abatment, Butterworths ltd., London, 1990.
3 Ganesan, V, Internal Combustion Engines, Tata McGraw-Hill Publishing Co., New Delhi, Fourth Edition, 2012.
4 L.Lberanek, Noise Reduction, Mcgrawhill Company, New York, 1993.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU769	**INTELLIGENT VEHICLES TECHNOLOGY**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To become familiar with various driver assistance systems.*
- *To comprehend the telematics in automotive systems.*
- *To recognize the automotive safety and security systems.*
- *To study about the comfort systems.*
- *To acquire the knowledge in various adaptive control systems.*

UNIT – I DRIVER ASSISTANCE SYSYTEMS [9]

Introduction, driver support systems – driver information, driver perception, driver convenience, driver monitoring. Vehicle support systems – general vehicle control, vehicle status monitoring and automated highway systems.

UNIT – II TELEMATICS [9]

Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition and application of Internet of Things (IoT) in automotive industry.

UNIT – III SAFETY SYSTEMS & SECURITY SYSTEMS [9]

Airbags, seat belt tightening system, collision avoidance and warning systems, child lock, antilock braking systems, Anti-theft technologies, smart card system and number plate coding.

UNIT – IV COMFORT SYSTEMS [9]

Active suspension systems, requirement and characteristics, different types, power steering, collapsible and tiltable steering column and power windows.

UNIT – V ADAPTIVE CONTROL SYSTEMS [9]

Adaptive cruise control, adaptive noise control, anti spin regulation, traction control systems and cylinder cut off technology and autonomous driving.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the various systems involved in driver support systems and their working principle.

CO2: Familiarize with global positioning systems, geographical information systems and navigation systems.

CO3: Comprehend the constructional and working features of safety systems and security systems

CO4: Recognize about the various comfort systems.

CO5: Acquire about the various adaptive control systems.

Text Book :

1 Ljubo Vlacic, Michel Parent and Fumio Harashima, Intelligent Vehicle Technologies, Butterworth-Heinemann publications, Oxford, 2001.

2 Ronald K Jurgen, Navigation and Intelligent Transportation Systems – Progress in Technology, Automotive Electronics Series, SAE, USA, 1998.

Reference Books :

1 Richard Bishop, Intelligent Vehicle Technology and Trends, Artech House, London, 2005.

2 William B Riddens, Understanding Automotive Electronics, Eighth edition, Butterworth-Heinemann, Woburn, 2017.

3 Robert Bosch, Automotive Handbook, Bently Publishers, Cambridge, Ninth Edition, 2014.

4 Bechhold, Understanding Automotive Electronics, SAE, 1998.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU771	**FINITE ELEMENT ANALYSIS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To develop mathematical models for Boundary Value Problems and their numerical solution.*
- *To apply the concepts of Finite Element Analysis to solve one dimensional problem.*
- *To determining field variables for two dimensional scalar variable problems.*
- *To determining field variables for two dimensional vector variable problems.*
- *To applying the need for Isoparametric transformation and the use of numerical integration.*

UNIT – I INTRODUCTION [9]

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT – II ONE-DIMENSIONAL PROBLEMS [9]

Finite element modeling – Coordinates and shape functions – Potential energy approach – Element matrices and vectors – Assembly for global equations – Boundary conditions – Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams – Finite element formulation of stiffness matrix and load vectors – Assembly to global equations – Boundary conditions – Solutions and post processing – Example problems.

UNIT – III TWO DIMENSIONAL PROBLEMS [9]

Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Plane stress, Plane strain and axisymmetric problems, engine cylinder.

UNIT – IV APPLICATIONS [9]

Eigen value problems – Application to one dimensional bar elements – lumped mass method – Application to engine cylinder heat transfer analysis (Conduction and Convection)

UNIT – V ISOPARAMETRIC FORMULATION [9]

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions techniques to dynamic problems – Introduction to analysis software.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Develop mathematical models for Boundary Value Problems and their numerical solution
CO2: Apply concepts of Finite Element Analysis to solve one dimensional problems
CO3: Select appropriate elements to solve physical and engineering problems with emphasis as an automobile engineering applications
CO4: Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
CO5: Apply the need for Isoparametric transformation and the use of numerical integration

Text Book :

1 Rao, S.S., The Finite Element Method in Engineering, Butterworth-Heinemann, Oxford, Sixth Edition, 2018.
2 Reddy, J.N. Introduction to the Finite Element Method, Tata McGraw Hill Co., New Delhi, Fourth Edition, 2018.

Reference Books :

1 Dhanaraj. R and Prabhakaran Nair. K, “Finite Element Analysis”, Oxford Publications, Chennai, 2015.
2 Tirupathi R.Chandrupatla and Ashok D.Belegundu, Introduction to Finite Elements in Engineering, Pearson Education Limited, New Delhi, International Edition, 2014.
3 David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Co., New Delhi, 2005
4 Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill Co., New Delhi, 2000.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU772	**INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To explain the concepts of industrial robots with respect to its classification, specifications and coordinate systems. Reviewing the need and application of robots in different engineering fields.*
- *To exemplify the different types of robot drive systems as well as robot end effectors.*
- *To apply the different sensors and image processing techniques in robotics to improve the ability of robots.*
- *To develop the robotic programs for different tasks and analyzing the kinematics motions of robot.*
- *To implement the robots in various industrial sectors and interpolating the economic analysis of robots.*

UNIT – I FUNDAMENTALS OF ROBOT [9]

Robot – Definition – Robot anatomy – Co-ordinate systems, Work envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint notations, Speed of motion, Pay load – Robot parts and their functions – Need for robots – Different applications.

UNIT – II ROBOT DRIVE SYSTEMS AND END EFFECTORS [9]

Finite element modeling – Coordinates and shape functions – Potential energy approach – Element matrices and vectors – Assembly for global equations – Boundary conditions – Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams – Finite element formulation of stiffness matrix and load vectors – Assembly to global equations – Boundary conditions – Solutions and post processing – Example problems.

UNIT – III SENSORS AND MACHINE VISION [9]

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors),Wrist Sensors, Compliance Sensors, Slip Sensors Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT – IV ROBOT KINEMATICS AND ROBOT PROGRAMMING [9]

Forward Kinematics, Inverse Kinematics and Differences – Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – DH matrices – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT – V IMPLEMENTATION AND ROBOT ECONOMICS [9]

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method and Rate of Return Method.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the concepts of industrial robots with respect to its classification, specifications and coordinate systems and application of robots in different engineering fields.
CO2: Exemplify the different types of robot drive systems as well as robot end effectors.
CO3: Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
CO4: Develop robotic programs for different tasks and analyze the kinematics motions of robot.
CO5: Implement robots in various industrial sectors and interpolate the economic analysis of robots.

Text Book :

1 Fu. K.S, Gonzalez. R.C, Lee. C.S.G, Robotics – Control, Sensing, Vision, and Intelligence, Tata McGraw Hill Co., New Delhi, 2015

2 Groover Mikell .P, Industrial Robotics -Technology Programming and Applications, Tata McGraw Hill Co., New Delhi, 2014.

Reference Books :

1 Craig J.J., Introduction to Robotics Mechanics and Control, Pearson Education, New York, 2009.
2 Deb S.R., Robotics Technology and Flexible Automation, Tata McGraw Hill Book Co., New Delhi, 2013.
3 Maja J Mataric, The Robotics Primer, Universities Press, Hyderabad, 2013.
4 Robin R. Murphy, Introduction to AI Robotics, PHI Learning Private Limited, New Delhi, 2000.

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SEMESTER – VII (Professional Elective - III)

		L	T	P	C
18AU773	**FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To remember the global trends and development methodologies of various types of products and services.*
- *To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems*
- *To recognize the requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification*
- *To perceive system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics*
- *To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer*

UNIT – I FUNDAMENTALS OF PRODUCT DEVELOPMENT [9]

Global Trends Analysis and Product decision - Social Trends - Technical Trends - Economic Trends - Environmental Trends - Political/Policy Trends. Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle – Product Development Planning and Management.

UNIT – II REQUIREMENTS AND SYSTEM DESIGN [9]

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management. System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT – III DESIGN AND TESTING [9]

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept Generation Techniques. Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation. Detailed Design - Component Design and Verification. Mechanical, Electronics and Software Subsystems - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing. Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration, Testing, Certification and Documentation.

UNIT – IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT [9]

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal.

UNIT – V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY [9]

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze various global trends and decide on the scope of a new product

CO2: Summarize requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.

CO3: Conceptualize new product integrating the hardware, software, controls, electronics and mechanical systems.

CO4: Develop test specifications and coordinate the respective activities with testing group, validate the product and confirm its performance as per design specification.

CO5: Develop product documentation as required.

Text Book :

1 Foundation Skills in Integrated Product Development (FSIPD), Published by NASSCOM, New Delhi, First Edition, 2013

2 Ulrich, Karl T. and Eppinger, Steven D, Product Design and Development, Tata McGraw-Hill Education, New Delhi, Fifth Edition, 2012.

Reference Books :

1 Kevin N. Otto, ― Product design – Techniques in Reverse Engineering and New Product Development, PEARSON, New Delhi, 2011

2 Hiriyappa B, Corporate Strategy – Managing the Business, Author House, 2013.

3 Mark S Sanders and Ernest J McCormick, Human Factors in Engineering and Design, Tata McGraw-Hill Education, New Delhi, Seventh Edition, 2013

4 Peter F Drucker, People and Performance, Butterworth – Heinemann [Elsevier], Oxford, 2004.

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU861	**FUEL CELLS AND APPLICATIONS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To define the concept, principle and working of fuel cells.*
- *To analyze the automotive applications of fuel cells.*
- *To evaluate about the performance of various fuel cell components.*
- *To identify different kinds of fueling.*
- *To analyze various kinds of substantial fuel cells.*

UNIT – I INTRODUCTION TO FUEL CELLS [9]

Introduction – working and types of fuel cell – low, medium and high temperature fuel cell, liquid and methanol types, proton exchange membrane fuel cell solid oxide, hydrogen fuel cells – Thermodynamics and electrochemical kinetics of fuel cells.

UNIT – II FUEL CELLS FOR AUTOMOTIVE APPLICATIONS [9]

Fuel cells for automotive applications – technology advances in fuel cell vehicle systems – onboard hydrogen storage – liquid hydrogen and compressed hydrogen – metal hydrides, fuel cell control system– alkaline fuel cell – road map to market.

UNIT – III FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE [9]

Fuel cell performance characteristics – current - voltage - voltage efficiency - power density - ohmic resistance - kinetic performance - mass transfer effects - membrane electrode assembly components - fuel cell stack – bi polar plate - humidifiers - cooling plates.

UNIT – IV FUELING [9]

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, carbon fibers – reformer technology – steam reforming, partial oxidation, auto thermal reforming – CO removal, fuel cell technology based on removal like bio-mass.

UNIT – V FUEL CYCLE ANALYSIS [9]

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fueled by natural gas and hydrogen and hybrid electric vehicle.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Summarize the concepts, principle and working of fuel cells.
CO2: Paraphrase the various automotive applications of fuel cells.
CO3: Interpolate the performance of various fuel cell components.
CO4: Assess the fuel processing techniques for fuel cells.
CO5: Comprehend the fuel cell analysis and application to fuel cell technologies.

Text Book :

1 Viswanathan B. and Scibioh Aulice M, Fuel Cells: Principles and Applications, Universities Press, Hyderabad, 2009, ISBN-8173715572 / 9788173715570

2 Thring. R.H, Fuel Cells for automotive applications, Professional engineering publishing, London, ISBN 1-860584233, 2004

Reference Books :

1 Frano Barbir, PEM Fuel Cells: Theory and Practice, Elsevier Academic Press, New York, 2012.

2 Gregor Hoogers, Fuel Cell Technology Handbook, SAE International, CRC Press, New York, ISBN 0-8493-0877-1, 2003

3 Mehrdad Ehsani, YiminGao, Sebastien E.Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell Vehicles: Fundamentals, Theory and Design, CRS Press, New York, 2009.

4 Ryan O'Hayre, Suk-Won Cha, Whitney Colella, "Fuel Cell Fundamentals", John Wiley & Sons, New York, Third Edition, 2016.

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU862	**SPECIAL PURPOSE VEHICLES**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To recognize the special purpose vehicles and their applications.*
- *To gain knowledge about the various types of excavators and graders.*
- *To perceive the knowledge about haulage vehicles and lift trucks.*
- *To discuss the functions of special purpose vehicles.*
- *To generalize the functions of special purpose vehicles.*

UNIT – I CRANES AND COMPACTION VEHICLES [9]

General description, specifications and functions, excavator mounted cranes, mobile cranes with strut and cantilever type jibs, tractor towed and tractor mounted cranes. General description, specification and functions, smooth wheeled rollers, pneumatic tired rollers, agricultural Rollers, sheep's foot rollers; vibrating compactors.

UNIT – II EXCAVATORS AND GRADERS [9]

General description, specification and functions, classification based on attachments, face shovel, drag shovel, hoe, drag-line and grab or clam shell, advantages and limitations. Description, specification of tractor towed graders and motor graders, classification and functions of graders, functional details of spreading, mixing, ditching, bank sloping, snow removal, stripping, scarifying, and finishing. Merits and limitations of graders.

UNIT – III HAULAGE VEHICLES AND LIFT TRUCKS [9]

General description, specification and functions, self-propelled and tractor towed haulage vehicles and pneumatic – tires, dumpers – front tipping; trucks – rear tipping, tractor towed semi-trailers and trailers (rear and side tipping, bottom dumping). General description, specification and functions, fork lift trucks, alternative front end equipment (attachments) – jib arm, shovel bucket, squeeze clamp, boom, fork extensions, barrel forks. Scissors lift trucks – applications in industry, advantages and disadvantages.

UNIT – IV ROOTERS AND SCARIFIERS AND SCRAPERS [9]

General description, specification and functions, tractor towed rooters and scarifiers {heavy duty (roller)/ light duty (grader)} back rippers for bull and angle dozers. General description, specification and functions, tractor towed and motorized scrapers, scraper work in cutting, cambering, side hill cutting, spreading on embankments, compaction of fill merits and demerits.

UNIT – V TRACTORS AND OTHER SPECIAL PURPOSE VEHICLES [9]

General description, specification and functions, light, medium and heavy wheeled tractors, crawler tracks mounted / wheeled-bull dozers, tilt dozers and angle dozers, front end loaders, factors affecting efficiency of output of tractors, simple problems, merits and demerits. General description, specification and functions, Ambulance, Oil tankers, surveillance vehicle, Television recording Mobile, Reefer vehicle , Double Decker bus, Vestibule bus and Fire fighting vehicle.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify about the specification and functions of various types of cranes and compacters.
CO2: Discuss the description and classifications based on their attachments of excavators and graders.
CO3: Comprehend the specifications and functions of haulage vehicles and trucks.
CO4: Identify the various descriptions and functions of towed rooters, scarifiers and scrapers.
CO5: Recognize special type of vehicles based on the need and purpose

Text Book :

1 Wong J Y, Theory of Ground Vehicles, John Wiley & Sons, New York, 2001.
2 Sean Bennet and Ian Andrew Norman, Heavy Duty Truck systems, Delmar Cengage learning, New York, Fifth Edition, 2011.

Reference Books :

1 Rodhiev and rodhiev, Tractors and Automobiles, MIR Publishers, Moscow, 1984.
2 Heinz Heisler, Vehicle and Engine Technology, , SAE International, New York, Second Edition, 1999.
3 Roninson E G, "Motor Graders", MIR Publications, Moscow, 1985.
4 Her Majesty's Stationery, Military Engineering – Volume 26

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU863	**ENGINEERING OPTIMIZATION**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the formulation of structural optimization problem.*
- *To enlighten the classical optimization techniques and single and multi-variable optimization*
- *To describe to develop techniques of unconstrained optimization*
- *To illuminate simulated annealing and ant colony techniques.*
- *To recognize the structural applications and design applications of optimization*

UNIT – I OPTIMUM DESIGN PRINCIPLES [9]

Introduction to optimum design – General principles of optimization – Problem formulation & their classifications – Classical optimization techniques – single and multi-variable optimization.

UNIT – II UNCONSTRAINED OPTIMIZATION TECHNIQUES [9]

Techniques of unconstrained optimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT – III CONSTRAINED OPTIMIZATION TECHNIQUES [9]

Optimization with equality and inequality constraints – Direct methods – Indirect methods using penalty functions, Lagrange multipliers – Geometric Programming.

UNIT – IV UNCONVENTIONAL OPTIMIZATION TECHNIQUES [9]

Heuristic algorithms – Genetic algorithms, Simulated annealing and Ant Colony techniques.

UNIT – V TRACTORS AND OTHER SPECIAL PURPOSE VEHICLES [9]

Structural applications – Design of simple truss members – Design applications – Design of simple axial, transverse loaded members for minimum cost and weight.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the formulation of structural optimization problem.
CO2: Enlighten the classical optimization techniques and single and multi-variable optimization
CO3: Describe to develop techniques of unconstrained optimization
CO4: Illuminate simulated annealing and ant colony techniques.
CO5: Recognize the structural applications and design applications of optimization

Text Book :

1 Kalyanmoy Deb, Optimization for Engineering design, Eastern Economy edition published by PHI publishers, India, 2012.

2 Rao, Singaresu S, Engineering Optimization – Theory & Practice, New Age International (P) Limited, New Delhi, Fourth Edition, 2009.

Reference Books :

1 David E.Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education. Inc, Published by Dorling Kindersley India (P) Ltd., New Delhi, Fourth Edition, 2009.

2 Kalyanmoy Deb, Optimization for Engineering design algorithms and examples, Prentice Hall of India Pvt. Ltd., New Delhi, 2009

3 Kwang.Y.Lee, Mohamed A.El-Sharkawi, Modern Heuristic Optimization Techniques, Theory and Applications to Power Systems, John Wiley and Sons Inc, New York, 2008

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU864	**FLEXIBLE AND LEAN MANUFACTURING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To gain knowledge on CAPP.*
- *To provide the knowledge about manufacturing different products with FMS.*
- *To simulate the manufacturing process using FMS software.*
- *To perceive the knowledge about lean manufacturing.*
- *To identify the various kinds of lean tools and JIT technology to optimize the process flow.*

UNIT – I GROUP TECHNOLOGY AND CAPP [9]

Formation of Part Families – Part Classification – Coding Systems – Optiz, Multi Class – Production Flow Analysis – Machine Cells Design – Clustering Methods – Modern Algorithms – Benefits of GT – CAPP – generative approach – variation approach.

UNIT – II FLEXIBLE MANUFACTURING SYSTEMS [9]

Introduction – Evolution – Definition – Need for FMS – Components of an FMS, types of systems, where to apply FMS technology, FMS work stations, Material handling and storage system – AGV. FMS layout configurations. Computer control system: Planning the FMS, analysis methods for FMS, applications and benefits.

UNIT – III FMS SOFTWARE, SIMULATION AND DATABASE [9]

Introduction-General Structure and Requirements – Types of software – Specification and selection – Trends – Application of simulation Software – Manufacturing data systems – Data flow – CAD/CAM considerations – Planning FMS database.

UNIT – IV LEAN MANUFACTURING [9]

Introduction – Traditional versus Lean Manufacturing's definition; VSM Types; Current State Map; Value Stream Icons; 3Ms-Muda, Mura,Muri-7 Types of Muda, Future State Map, TAKT - Time Ford Production System, Job shop concepts – Concept of lean and Toyota's foray in lean.

UNIT – V LEAN TOOLS AND JIT [9]

Concept of Kaizen; Steps involved in Kaizen Deployment, JIT System; Principles of JIT – Kanban – Concept of Pull and push system, Single Minute Exchange of Dies (SMED), Poka yoke – Types and use of Poka yoke system , Production Leveling, Cultural Change, Line Balancing

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the concepts of group technology and CAPP.
CO2: Explain processing stations and material handling systems used in FMS environments.
CO3: Design and analyze FMS using simulation and analytical techniques.
CO4: Comprehend the concepts in Lean Manufacturing.
CO5: Identify the tools and methods of Lean Manufacturing.

Text Book :

1 Groover. M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice-Hall of India Pvt.Ltd, New Delhi, 2009.
2 Don Tapping, Tom Luyster and Tom Shuker, Value Stream Management: Eight Steps to Planning, Mapping and Sustaining Lean Improvements, Productivity Press, London, 2006.

Reference Books :

1 William W Luggen, Flexible Manufacturing Cells and System, Prentice Hall of Inc, New Jersey, 1991.
2 Askin R G and Goldberg J B, Design and Analysis of Lean Production Systems, John Wiley & Sons Inc., New York, 2003.
3 N.Gopalakrishnan, Simplified Lean manufacture, PHI Learning Private Limited, New Delhi, 2010.
4 Masaaki Sato, The Toyota Leaders – An Executive Guide, Vertical Inc, New York, 2008.

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU865	**ENTREPRENEURSHIP DEVELOPMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To explain the types, characteristics of entrepreneurship and its role in economic development.*
- *To apply the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.*
- *To select the appropriate form of business ownership in setting up an enterprise.*
- *To apply the fundamental concepts of finance and accounting to enterprise.*
- *To identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.*

UNIT – I ENTREPRENEURSHIP [9]

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth – Economic, Non-Economic, Government Actions.

UNIT – II MOTIVATION [9]

Entrepreneurial Motivation: Theories and Factors, Achievement Motivation –Entrepreneurial Competencies – Entrepreneurship Development Programs – Need, Objectives – Business Game, Thematic Apperception Test, Self Rating, Stress management.

UNIT – III BUSINESS [9]

Small Enterprises – Definition, Characteristics, Project Identification and selection – Project Formulation: Significance, content, formulation of project report – Project Appraisal: Concept and method – Ownership Structures: Selection & Pattern.

UNIT – IV FINANCING AND ACCOUNTING [9]

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management.

UNIT – V SUPPORT TO ENTREPRENEURS [9]

Sickness in small Business: Concept, Signals, Symptoms, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in Small Scale Enterprise – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation, Investment.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the types, characteristics of entrepreneurship and its role in economic development.

CO2: Apply the theories of achievement motivation and the principles of entrepreneurship development program.

CO3: Select the appropriate form of business ownership in setting up an enterprise.

CO4: Apply the fundamental concepts of finance and accounting to enterprise.

CO5: Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

Text Book :

1 S.S.Khanka, Entrepreneurial Development, S.Chand & Co. Ltd. Ram Nagar, New Delhi, Fourth Edition, 2010.

2 Kuratko & Hodgetts, Entrepreneurship – Theory, process and practices, Thomson learning, New Delhi, Ninth Edition, 2009.

Reference Books :

1 Hisrich R D and Peters M P, Entrepreneurship, Tata McGraw-Hill Book Co. New Delhi, Fifth Edition 2002.

2 Mathew J Manimala, Entrepreneurship theory at cross roads: paradigms and praxis, Dream tech, New Delhi, Second Edition, 2006.

3 Rabindra N. Kanungo, Entrepreneurship and innovation, Sage Publications, New Delhi, 1998.

4 Singh, A. K., Entrepreneurship Development and Management, University Science Press, Oxford, 2009.

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SEMESTER – VIII (Professional Elective - IV)

		L	T	P	C
18AU866	**ENGINEERING ECONOMICS AND FINANCE**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the capacity to deal with workplace concerns and the business side of engineering.*
- *To provide them with an awareness of the language of accounting and engineering economy.*
- *To acquire the knowledge of cash flow.*
- *To analyze the various kinds of replacement and maintenance methods.*
- *To analyze the value of depreciation.*

UNIT – I INTRODUCTION TO ECONOMICS [9]

Introduction to Economics – Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Elements 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 and Process planning.

UNIT – II VALUE ENGINEERING [9]

Make or buy decision, Value engineering – Function, aims, and 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 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify with economic decision making problems by using simple economic analysis.
CO2: Recognize a value engineering procedure.
CO3: Know the methods of comparison of alternatives
CO4: Comprehend the replacement and maintenance analysis.
CO5: Calculate the depreciation and evaluation of public alternatives

Text Book :

1 Panneer Selvam, R, Engineering Economics, Prentice Hall of India Ltd, New Delhi, 2004.
2 Donald.G. Newman, Jerome.P.Lavelle, Engineering Economics and analysis, Engg. Press, Texas, 2002.

Reference Books :

1 Chan S.Park, Contemporary Engineering Economics, Prentice Hall of India, New Delhi, 2002.
2 Degarmo, E.P., Sullivan, W.G and Canada, J.R, Engineering Economy, Macmillan, New York, 1984.
3 Grant.E.L.,Ireson.W.G., and Leavenworth, R.S, Principles of Engineering Economy, Ronald Press, New York,1976.
4 Smith, G.W., Engineering Economy, Lowa State Press, Iowa, 1973.

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18AU867	**OPERATIONS RESEARCH AND VEHICLE ROUTING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To form linear programming model.*
- *To analyze the various methods under transportation model for testing the closeness their results.*
- *To apply the concepts of PERT and CPM to short out the processes.*
- *To analyze the various replacement and sequencing models for arriving at optimal decisions.*
- *To analyze the inventory and queuing theories in domain specific situations resources.*

UNIT – I LINEAR MODEL [9]

The phases of OR study – formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique – Big M method.

UNIT – II TRANSPORTATION PROBLEM [9]

Optimal solution by north west corner method – least cost method – vogels approximation method – optimality test – MODI method. Assignment problem – formulation – Hungarian method – unbalanced assignment problem.

UNIT – III NETWORK MODELS [9]

Shortest route – minimal spanning tree – maximum flow models – Shortest route problem – project network - CPM and PERT network – critical path scheduling.

UNIT – IV SEQUENCING MODELS [9]

Job & Flow shop sequencing – Sequencing problem: models with n jobs with 2 machines – problem with n jobs with 3 machines – EOQ – ABC analysis.

UNIT – V QUEUING THEORY AND VEHICLE ROUTING [9]

Queuing models – queuing systems and structures – notation – parameter – single server models – basic concepts of vehicle routing problems – applications of meta – heuristics.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply linear programming model and assignment model to domain specific situations
CO2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results
CO3: Apply the concepts of PERT and CPM for decision making and optimally managing projects
CO4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions
CO5: Analyze the inventory and queuing theories and apply them in domain specific situations.

Text Book :

1 Rajagopal K, Operation Research, PHI Learning Private Ltd, 2012.
2 Hamdy Ataha, Operations research an introduction, PHI/Pearson education, New Delhi, Ninth Edition 2011.

Reference Books :

1 Srinivasan G, Operations research principles and applications, PHI/Pearson education, New Delhi, Second Edition, 2010
2 Pannerselvam R, Operations research, PHI/Pearson education, New Delhi, Second Edition, 2009.
3 The Vehicle routing problem, Society for Industrial and Applied Mathematics, 2002.
4 Sharma. J.K, Operations research theory and applications, Macmillan India, New Delhi, Fifth Edition, 2013

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18AU868	**NOISE, VIBRATION AND HARSHNESS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To recognize the sources of vibration.*
- *To assess the various effects of noise and shocks on people.*
- *To identify the sources, prediction and control of engine noise and vibration.*
- *To analyze the transportation noise, vibration sources and control.*
- *To describe the various noise and vibration measuring techniques.*

UNIT – I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION [9]

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping.

UNIT – II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE [9]

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT – III ENGINE NOISE AND VIBRATION—SOURCES, PREDICTION, AND CONTROL [9]

Introduction to Engine Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers.

UNIT – IV TRANSPORTATION NOISE AND VIBRATION SOURCES-PREDICTION AND CONTROL [9]

Introduction to Transportation Noise and Vibration Sources, Tire/Road Noise—Generation, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT – V NOISE AND VIBRATION TRANSDUCERS AND MEASURING TECHNIQUES [9]

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Remember the sources of vibration, damping of vibration.
CO2: Assess the various effects of noise and shocks on people.
CO3: Identify the sources, prediction and control of engine noise and vibration.
CO4: Analyze the transportation noise, vibration sources and control.
CO5: Describe the various noise and vibration measuring techniques.

Text Book :

1 McConnell K, Vibration Testing Theory and Practice, John Wiley, New York, 1995.
2 Norton M P, Fundamental of Noise and Vibration, Cambridge University Press, Cambridge, 1989

Reference Books :

1 Allan G. Piersol , Thomas L. Paez, Harris' shock and vibration hand book, Tata McGraw-Hill Education, New Delhi, 2010.
2 Clarence W. de Silva , Vibration Monitoring, Testing, and Instrumentation, CRC Press, New York, 2007.
3 David A.Bies and Colin H.Hansen, Engineering Noise Control: Theory and Practice, Spon Press, London, 2009
4 Matthew Harrison, Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Elsevier Butterworth-2004

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18AU869	**VEHICLE DEALERSHIP MANAGEMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To comprehend the basic concepts of dealership.*
- *To cognize the structuring and monitoring process of showroom management.*
- *To recognize the fundamentals of services and repair scheduling.*
- *To identify the concept of management in parts ordering and servicing.*
- *To apply the practical knowledge by planning the case studies.*

UNIT – I INTRODUCTION [9]

Understanding dealership infrastructure requirements. Furnishing dealership. Preparing dealer manual.

UNIT – II SHOWROOM MANAGEMENT [9]

Contemporary showroom management. Institutionalizing, structuring and monitoring the sales process, managing the showroom floor and the sales team. Retail developments and industry trends

UNIT – III SERVICE MANAGEMENT [9]

Service management, process and fundamentals, repair order analysis, productivity and efficiency, scheduling, loading, warranties and service retention

UNIT – IV PARTS MANAGEMENT [9]

Parts management, inventory control, staffing and productivity, ordering parameters, parts marketing, merchandising, retailing and trade activities.

UNIT – V CASE STUDY [9]

Applying theory in practice working case study of an actual dealership, group presentations and action planning.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the basic concepts of dealership.
CO2: Discuss the structuring and monitoring process of showroom management.
CO3: Recognize the fundamentals of services and repair scheduling.
CO4: Identify the concept of management in parts ordering and servicing.
CO5: Apply the practical knowledge by planning the case studies.

Text Book :

1 A. Sivakumar, Retail Management, Excel Books, New Delhi.1997.
2 Kapil Sharma, Marketing Management, Global India Publication Pvt. Ltd., New Delhi, 2009.

Reference Books :

1 KVS Madaan, Fundamentals of Retailing, Tata McGraw Hill, New Delhi, 2009.
2 Gibson G.Vedamani, Retail Management, Jaico Publishing House, New Delhi, 2003.

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18AU871	**RELIABILITY IN AUTOMOBILE ENGINEERING**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To recognize the concept of reliability.*
- *To comprehend the concept of various reliability and system models.*
- *To compare various types of design and analysis of failures.*
- *To explain the reliability testing*
- *To remember the reliability analysis.*

UNIT – I CONCEPT OF RELIABILITY [9]

Definition of reliability – reliability Vs quality – reliability function – MTTF – hazard rate function – bathtub curve – Derivation of the reliability function – constant failure rate model – Time dependent failure models – Weibull distribution – Normal distribution- The logarithmic normal distribution. Choosing the best distribution and assessing the results.

UNIT – II RELIABILITY OF SYSTEM AND MODELS [9]

Serial configuration – parallel configuration – combined series parallel systems system structure function, Minimal cuts and Minimal paths – Markov analysis – Load sharing systems, standby system, degraded systems , three state devices – covariate models , static models, dynamic models and physics of failure models.

UNIT – III DESIGN FOR RELIABILITY [9]

Reliability design process – system effectiveness – Economic analysis and life cycle cost – Reliability allocation – ARINC, AGREE- Design methods – parts and material selection, Derating, stress-strength analysis – Failure Analysis – Identification of failure mode – Determine of causes – Assessment of effects – classification of severity computation of critically index – corrective action – System safety and FTA.

UNIT – IV ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING [9]

Data collection – Empirical methods – ungrouped and grouped complete, censored data – static life estimation- test time calculation – Burn in testing, Acceptance, sequential, binomial testing – Accelerated life testing – other acceleration models – Experimental design – Reliability growth process idealized growth curve – various growth models – Identifying failure and repair distributions.

UNIT – V RELIABILITY ANALYSIS OF A FMEA [9]

System analysis – Determination of system components and system elements, Classification of system elements, Determination of the reliability structure, Determination of the reliability of system elements, calculation of the system reliability. Failure mode and effects analysis (FMEA) – basic principles and general fundamentals of FMEA methodology, FMEA according to VDA 86 (Form FMEA), Example of a design FMEA according to VDA 86.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the concept of reliability.
CO2: Comprehend the concept of various reliability and system models.
CO3: Compare various types of design and analysis of failures.
CO4: Explain the reliability testing
CO5: Remember the reliability analysis.

Text Book :

1 Patrick D T o'connor, Andre kleyner, Practical Reliability Engineering, John-Wiley and Sons ltd, New Delhi, Fifth Edition, 2012.
2 David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth, London, Seventh Edition, 2005.

Reference Books :

1 Bernd Bertsche, Reliability in Automotive and Mechanical Engineering: Determination of Component and System Reliability, Springer, London, 2008
2 Charles E Ebling, An introduction to Reliability and Maintainability Engineering, Tata Mc Graw-Hill Education, New Delhi, 2000.
3 Way kuo, Rajendra Prasad V, Frank A and Tillman, Ching-lai Hwang, Optimal reliability design and applications, Cambridge University Press Pvt. Ltd., Cambridge, 2001
4 L.S.Srinath, “Reliability Engineering”, East West Press, New Delhi, Fourth Edition, 2005.

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18AU872	**PRODUCTION PLANNING AND CONTROL**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To recognize the objectives, functions, applications of PPC.*
- *To comprehend the role of production planning and control activities in manufacturing process.*
- *To summarize various aggregate production planning techniques.*
- *To solve the routing and scheduling problems.*
- *To explain different Inventory control techniques.*

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.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recognize the objectives, functions, applications of PPC.
CO2: Comprehend the role of production planning and control activities in manufacturing process.
CO3: Summarize various aggregate production planning techniques.
CO4: Solve the routing and scheduling problems
CO5: Explain different Inventory control techniques

Text Book :

1 James. B. Dilworth, Operations management – Design, Planning and Control for manufacturing and services, Tata Mcgraw Hill, New York, International Edition 1992.
2 Martand Telsang, Industrial Engineering and Production Management, S. Chand and Company, New Delhi, First Edition 2000.

Reference Books :

1 K C Jain and L N Agarwal, Production Planning and Control, Khanna Publishers, New Delhi, Sixth Edition, 2008.
2 Elwood S.Buffa, and Rakesh K.Sarin, Modern Production / Operations Management, John Wiley and Sons, New Delhi, Eighth Edition, 2000.
3 M Mahajan, Production Planning and Control, Dhanpat Rai & Co., New Delhi, 2010.
4 O P Khanna, Industrial Engineering and Management, Dhanpat Rai & Co., New Delhi, 2009.

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SEMESTER – VIII (Professional Elective - V)

		L	T	P	C
18HS002	**TOTAL QUALITY MANAGEMENT** (Common To All Branches)	3	0	0	3

Prerequisite: -

Objectives:

- *To explain the basic concepts of total quality management.*
- *To explain the various principles of total quality management.*
- *To describe the various statistical process control concepts.*
- *To discuss the various tools in Total quality management.*
- *To explain the different quality systems in manufacturing and service sectors.*

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 implementation steps – Quality council-Importance of leadership and motivation in TQM - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT – II TQM PRINCIPLES [9]

Quality statements - Customer perception of quality – Customer complaints, Customer retention. Employee involvement, Empowerment, Team and Teamwork, Recognition and Reward - Continuous process improvement – Juran trilogy, PDSA cycle, 5s, 8D Methodology - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT – III STATISTICAL PROCESS CONTROL [9]

The seven traditional tools of quality – Measurement of central tendency and dispersion, population and sample, normal curve, control chart (X,R,p) for variable and attributes, process capability - Seven new management tools – Six-sigma Concepts.

UNIT – IV TQM TOOLS [9]

Bench marking – reason , process – Quality circles concepts - FMEA – stages, types– Quality Function Deployment (QFD) – Taguchi quality loss function –TPM – concepts, improvement needs –Performance measures-criteria – Quality Cost.

UNIT – V QUALITY SYSTEMS [9]

Need for ISO 9000 – ISO 9001-2014, ISO 14000 Quality System – elements, implementation, Documentation. Quality auditing – concepts, requirements and benefits, non-conformance report – Case studies of TQM implementation in manufacturing and service sectors.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the fundamental concepts of total quality management.
CO2: Illustrate the Various TQM principles for continuous process improvement
CO3: Classify the statistical tools to control and improve the quality of the products and services.
CO4: Describe the tools and techniques to improve the quality concept
CO5: Explain the quality system in manufacturing and service sectors.

Text Book :

1 Dale H.Besterfiled, et at., Total Quality Management, Pearson Education Asia, Indian Reprint , New Delhi, Third Edition, 2016.
2 Janakiraman,B and Gopal, R.K, Total Quality Management – Text and Cases, Prentice Hall (India) Pvt. Ltd., New Delhi, Third Edition, 2015.

Reference Books :

1 Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India)Pvt. Ltd.,, New Delhi, Frist Edition, 2014
2 James R. Evans and William M. Lindsay, The Management and Control of Quality, South-Western (Thomson Learning), New Delhi, Ninety Edition, 2015.
3 Subburaj R, Total Quality Management, Tata McGraw Hill, New Delhi, Frist Edition, s2014
4 Eugence Mckenna and Nic Beach, Total Quality Management, Pearson Education Limited, New Delhi, Second Edition, 2014.

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Open Elective

		L	T	P	C
18CE862	**SMART MATERIALS AND SMART STRUCTURES**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To give an insight into the developments regarding smart materials and their use in structures.*
- *To describe various aspects of measuring techniques.*
- *To elaborate the functioning of sensors.*
- *To describe concept of actuators, types and its materials.*
- *To discuss the concept of signal processing and control systems.*

UNIT – I INTRODUCTION [9]

Introduction to smart materials and structures - instrumented structures functions and response – sensing systems - self diagnosis - signal processing consideration - actuation systems and effectors.

UNIT – II MEASURING TECHNIQUES [9]

Strain measuring techniques using electrical strain gauges, types – resistance – capacitance – inductance – wheatstone bridges – pressure transducers – load cells – temperature compensation – strain rosettes.

UNIT – III SENSORS [9]

Sensing technology – types of sensors – physical measurement using piezo electric strain measurement – inductively read transducers – LVDT – Fibre optic techniques - chemical and bio-chemical sensing in structural assessment – absorptive chemical sensors – spectroscopes – Fibre optic chemical sensing systems and distributed measurement.

UNIT – IV ACTUATORS [9]

Actuator techniques – actuator and actuator materials – piezoelectric and electrostrictive material – magnetostrictive material – shape memory alloys – electro rheological fluids – electromagnetic actuation – role of actuators and actuator materials.

UNIT – V SIGNAL PROCESSING AND CONTROL SYSTEMS [9]

Data acquisition and processing – signal processing and control for smart structures – sensors as geometrical processors – signal processing – control system – linear and nonlinear.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Discriminate the functions and response of instrumented structures and the role of effectors and actuators in smart structures.
CO2: Describe the operating principles of strain gauges, pressure transducers and load cells.
CO3: Summarize the applications of sensors.
CO4: Describe actuators in smart structures.
CO5: Apply the concepts of data acquisition and signal processing in smart structure to minimize the realistic engineering constraint.

Text Book :

1 Brain Culshaw., Smart Structure and Materials, Artech House Publishers, London, Third Edition, 2015.
2 Srinivasan, A.V, D. and Michacl Mc Farland., Smart Structures, Cambridge University Press, New Delhi, Second Edition, 2010..

Reference Books :

1 Srinath, S., Experimental Stress Analysis, Tata McGraw-Hill, New Delhi, Third Edition, 2010.
2 Dally, J.W. and Riley, W.F, Experimental Stress Analysis, Tata McGraw-Hill, New Delhi, First Edition, 2002.
3 Clarence, W. de Silva., Sensors and Actuators, Taylor & Francis, UK, Second Edition, 2015.
4 http://nptel.ac.in/courses/112104173/

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K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Open Elective

		L	T	P	C
18CE867	**MUNICIPAL WASTE AND MANAGEMENT**	3	0	0	3

Prerequisite: *Environmental Engineering II*

Objectives:

- *To provide comprehensive overview of municipal waste and management.*
- *To learn about on-site storage and processing of solid waste.*
- *To provide knowledge on collection and transportation of waste.*
- *To impart knowledge about the processing of municipal solid waste.*
- *To impart knowledge about safe disposal of municipal solid waste.*

UNIT – I SOURCES AND TYPES OF MUNICIPAL SOLID WASTES [9]

Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes-characteristics – methods of sampling and characterization- Effects of improper disposal of solid wastes – public health effects- Principle of solid waste management – social & economic aspects - Public awareness-Role of NGOs- Legislation.

UNIT – II ON-SITE STORAGE AND PROCESSING [9]

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

UNIT – III COLLECTION AND TRANSFER [9]

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions – Usage GPS in route optimization – Application of GIS in collection and transfer of waste.

UNIT – IV OFF-SITE PROCESSING [9]

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.

UNIT – V TREATMENT & DISPOSAL [9]

Dumping of solid waste, Building Demolition and Construction Waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Characterize the solid waste based on source, type and composition and also emphasize the effects of its improper disposal.
CO2: Identify and suggest suitable on-site processing methods.
CO3: Identify the suitable method for collection, segregation and transportation of solid waste.
CO4: Select and adopt the suitable off-site processing techniques according to Indian conditions.
CO5: Identify and suggest appropriate disposal methods for solid and wastes.

Text Book :

1 Tchobanoglous, G. and Frank Kreith., Hand Book of Solid Waste Management, McGraw-Hill, Inc, New Delhi, Second Edition, 2002.
2 Ramachandra, T. V., Management of Municipal Solid Waste, TERI Press, New Delhi, First Edition, 2009.

Reference Books :

1 Worrell, William A. and AarneVesilind, P., Solid Waste Engineering, Cengage Learning Asia PTE Limited, Singapore, Second Edition, 2012.
2 Rao, M.N, Sultana, Razia Kota, and Sri Harsha., Solid and Hazardous Waste Management: Science and Engineering, Butterworth-Heinemann, Burlington, First Edition, 2016.
3 John Pichtel., Waste Management Practices: Municipal, Hazardous, and Industrial, CRC Press, Florida, Second Edition, 2014.
4 Freeman, H. M., Standard Handbook of Hazardous Waste Treatment and DisposalII, McGraw-Hill, Inc, Noida, Second Edition, 1997.

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K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Open Elective

		L	T	P	C
18CE766	**ENVIRONMENTAL IMPACT ASSESSMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To diagnose the importance of Environmental Impact Assessment (EIA) &various types of EIA.*
- *To describe different methods of EIA.*
- *To illustrate the impact on various environments and role of stake holders in EIA.*
- *To explain the environmental impact management plans for mitigation of adverse impact on environment.*
- *To fathom out case studies of environmental impact assessment for different infrastructure projects.*

UNIT – I INTRODUCTION [9]

Impact of development projects – Sustainable development- Need for Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA-Stages of EIA, Types of EIA.

UNIT – II METHODOLOGIES [9]

Methods of EIA – Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives.

UNIT – III PREDICTION AND ASSESSMENT [9]

Assessment of Impact on land, water, air, social & cultural activities and on flora & fauna- Mathematical models- Public participation.

UNIT – IV ENVIRONMENTAL MANAGEMENT PLAN [9]

Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the issues related to the Project Affected People Post project monitoring.

UNIT – V CASE STUDIES [9]

EIA for infrastructure projects – Dams – Highways – Multi-storey Buildings – Water Supply and Drainage Projects – Waste water treatment plants, STP.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Carry out scoping and screening of developmental projects for environmental and social assessments.
CO2: Analyse different methodologies for environmental impact assessment.
CO3: Evaluate the impact on various environments and role of stake holders in EIA.
CO4: Promote environmental impact management plans for mitigation of adverse impact on environment.
CO5: Prepare and evaluate case studies of environmental impact assessment reports for different infrastructure projects.

Text Book :

1 Canter, R.L., Environmental Impact Assessment, McGraw-Hill Higher Education, New Delhi, Second Edition, 1995.
2 Shukla, S.K. and Srivastava, P.R., Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, Second Edition, 2017.

Reference Books :

1 Rau,John G. and Hooten, David.C., Environmental Impact Analysis Handbook, McGraw Hill Book Company, New Delhi, 1990..
2 Environmental Assessment Source book, Vol. I, II & III. The World Bank, Washington, D.C, 1991.
3 Judith Petts., Handbook of Environmental Impact Assessment Vol. I & II, Blackwell Science, Boston, 1999.
4 http://nptel.ac.in/courses/120108004/module3/lecture3.pdf

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K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Open Elective

		L	T	P	C
18CE865	**HOUSING, PLANNING AND MANAGEMENT**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To provide the basic concepts of housing at all the levels.*
- *To give ideas related to different housing programmes.*
- *To make the students familiar with planning and design of housing projects.*
- *To be known with the techniques in cost effective construction materials and methods.*
- *To develop complete awareness about financing of housing projects and project appraisal.*

UNIT – I INTRODUCTION TO HOUSING [9]

Definition of Basic Terms – House, Home, Household, Apartments, Multi storey Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies –Introduction to National Building Code - Development Control Regulations, Institutions for Housing at National, State and Local levels – Tamilnadu combined development and building rules -2019.

UNIT – II HOUSING PROGRAMMES [9]

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

UNIT – III PLANNING AND DESIGN OF HOUSING PROJECTS [9]

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems).

UNIT – IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS [9]

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation.

UNIT – V HOUSING FINANCE AND PROJECT APPRAISAL [9]

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units, Rents, Recovery Pattern (Problems).

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe the basic concepts of housing at all the levels
CO2: Discuss sustainable housing policies and programmes
CO3: Accomplish planning, evaluation, construction and financing of housing projects.
CO4: Recommend various construction strategy to save man power, materials, time and money
CO5: Appraise the housing finance and identify on-going project with cost effective ideas and its implementation methods.

Text Book :

1 Chandrasekar, K. and Karthikeyan, N., Housing Planning and Management, CGS Publisher, New Delhi, First Edition, 2016.
2 Jain, R., Housing Finance in India, A.K. Publications, New Delhi, Third Edition, 2011.

Reference Books :

1 Tamil Nadu Combined Development and Building Rules, 2019.
2 UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, First Edition, 1994.
3 National Urban Housing and Habitat Policy, New Delhi, 2007.
5 http://nptel.ac.in/courses/105103093/

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Open Elective

		L	T	P	C
18CS869	**INTERNET OF THINGS**	3	0	0	3

Prerequisite: *Basic knowledge of Microprocessors and Microcontrollers*

Objectives:

- *To study basic concepts of Internet of things.*
- *To know IoT platform design methodology.*
- *To learn IoT physical devices and endpoints.*
- *To gain knowledge in ARDUINO for IoT.*
- *To get the idea of Hadoop and MapReduce*

UNIT – I BASICS OF INTERNET OF THINGS [9]

Definition – Characteristics – Physical design of IoT– Logical design of IoT– IoT Enabling Technologies – IoT Levels and deployment templates – Domain specific IoT: Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Life style.

UNIT – II IoT PLATFORM DESIGN METHODOLOGY [9]

IoT and M2M:M2M – Difference between IoT AND M2M – SDN and NFV for IoT.IoT System management – Need for system management – SNMP – Network operator requirements – NETCONF –YANG – IoT systems management with NETCONF-YANG – IoT design methodology – Case study : Weather Monitoring.

UNIT – III IoT PHYSCIAL DEVICES [9]

IoT device – Raspberry Pi Board – Linux on Raspberry Pi – Raspberry Pi interfaces – Programming Raspberry Pi with python – Other IoT devices – Cloud storage models and communication APIs: WAMP – Xively cloud for IoT– Django – designing RESTful web API.

UNIT – IV IoT WITH ARDUINO [9]

Arduino Basics: Hardware Requirements – Software Requirements – Arduino Programming. Internet Connectivity: Arduino Uno Wired Connectivity – Arduino Uno Wireless Connectivity – Arduino Yun Wireless Connectivity. Communication Protocols: HTTP – MQTT.

UNIT – V DATA ANALYTICS FOR IoT [9]

Apache Hadoop – Hadoop MapReduce for batch data analysis – Apache Oozie – apache spark – Apache storm – Real time analysis using Apache storm. Tools for IoT: Chef – Puppet.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the technologies and applications of IoT.
CO2: Construct IoT platform using design methodology.
CO3: Develop IoT device using Raspberry Pi Board.
CO4: Build up IoT device using Arduino Board.
CO5: Familiarize with data analytics for IoT

Text Book :

1 Arsdeep Bahga and Vijay Madisetti, Internet of Things – Hands on approach, university press India private Limited, First Edition, 2015.

Reference Books :

1 Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, United States, First Edition, 2011.
2 David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, New York, First Edition, 2010.
3 Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things - Key applications and Protocols, Wiley, United States. Second Edition, 2012.
4 http://nptel.ac.in/courses/106105081

R 2018

K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Open Elective

18CS002	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

Prerequisite: *Fundamentals of C programming concepts*

Objectives:

- *To know the fundamentals of Java programming language.*
- *To equip students with comprehensive knowledge on core concepts of java like overloading.*
- *To gain knowledge in interfaces and exception handling*
- *To get idea on threads and multithreaded programming*
- *To study the I/O operations and string manipulations and concepts of database connectivity.*

UNIT – I JAVA FUNDAMENTALS [9]

The Java Buzzwords – Data Types – Variables – Arrays – Operators – Control Statements – Class Fundamentals – Declaring Objects – Methods – Method Overloading – Objects as Parameters – Returning Objects – Recursion –this keyword – Garbage Collection.

UNIT – II CONSTRUCTORS AND INHERITANCE [9]

Constructors – Constructor Overloading–Access Control – static – final – Nested and Inner Class – Inheritance : Basics –Super – Multilevel – Hierarchical – Method Overriding – Abstract class –Final with Inheritance.

UNIT – III PACKAGES, INTERFACES AND EXCEPTION HANDLING [9]

Packages – Access Protection – Importing Packages – Interfaces – Default Interface Methods – Static Methods in Interface – Exception Handling Fundamentals – Types – Uncaught Exceptions –Try and Catch – Multiple Catch – Nested Try – Throw – Throws – Finally –Array List-Wrapper Classes.

UNIT – IV MULTITHREADED PROGRAMMING AND I/O OPERATIONS [9]

Java Thread Model – Main Thread – Creating a Thread – Creating Multiple Threads – is Alive and join Methods – Thread Priorities - Synchronization – Inter thread Communication – Suspending, Resuming, and Stopping Threads – Obtaining a Thread's State – Using Multithreading – I/O Basics – Reading Console Input – Writing Console Output – The Print Writer Class – Reading and Writing Files – Automatically Closing a File – Scanner class.

UNIT – V STRING AND DATABASE CONNECTIVITY [9]

The String Constructors – String Length – Character Extraction – String Comparison – Searching Strings – Modifying a String – Data Conversion using value of method – Methods in String Buffer – JDBC Product Components – JDBC API – JDBC Driver Manager – JDBC Test Suite – JDBC-ODBC Bridge – JDBC Architecture – Establishing Connection – Handling SQL Exceptions.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply java programming fundamentals to solve real world problem.
CO2: Implement the concept of overloading and inheritances.
CO3: Examine important features of java like packages, interfaces and exception handling.
CO4 Illustrate the features of multithreaded programming and I/O operations.
CO5: Demonstrate the concepts of string manipulations and database connectivity.

Text Book :

1 Herbert Schildt, Java - The Complete Reference, Oracle Press, McGraw-Hill Education, New Delhi, Tenth Edition, 2018.
2 Cay S. Horstmann, Core Java Volume 1 - Fundamentals, Prentice Hall, US, Tenth Edition, 2015.

Reference Books :

1 Herbert Schildt, Java - A Beginner Guide, Oracle Press, McGraw-Hill Education, New Delhi, Sixth Edition, 2014.
2 Joshua Bloch, Effective Java: A Programming Language Guide, Addison-Wesley Professional, US, Third Edition, 2018.
3 Allen B. Downey and Chris Mayfield, Think Java: How to Think Like a Computer Scientist, O'Reilly, California, First Edition, 2016.
4 https://onlinecourses.nptel.ac.in/noc19_cs07/preview

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18CS711	**BIG DATA AND CLOUD COMPUTING**	3	0	0	3

Prerequisite: *Basic Knowledge in database management and distributed systems.*

Objectives:

- *To gain basic knowledge about Big Data and its tool.*
- *To get the knowledge about comprehensive tools of Big Data.*
- *To learn the fundamentals and working principles of Hive and Pig.*
- *To learn about basic concepts of Cloud Computing.*
- *To learn the real time implementation of Cloud.*

UNIT – I BASCIS OF BIG DATA AND HADOOP [9]

Classification of Digital Data – Characteristics of Data – Evaluation of Data – Definition of Big Data - Challenges with Big Data – Traditional Business Intelligence versus Big Data – A Typical Hadoop Environment – Definition of Big Data Analytics – Classification of Analytics – Top Challenges facing Big Data – Data Science and Scientist – Terminologies used in Big Data Environments – Few Top Analytic Tools – NoSQL – Types of NoSQL Database – Advantages of NoSQL – Use of NoSQL in Industry – NoSQL Vendors – SQL versus NoSQL – NewSQL– Hadoop – Features of Hadoop – Versions of Hadoop – Hadoop Overview – HDFS – Processing Data with Hadoop – Managing Resources and Applications with Hadoop YARN – Interacting with Hadoop Ecosystems.

UNIT – II MONGODB , CASSANDRA AND MAPREDUCE PROGRAMMING [9]

MongoDB – Terms used in RDBMS and MongoDB – Data Types in MongoDB – MongoDB Query Language – Cassandra: Features of Cassandra – CQL Data Types – CQLSH – Key Spaces – CRUD – Collections – Using a Counter – TTL – Alter Commands – Import and Export – Query System Tables. MapReduce: Introduction – Mapper – Reducer – Combiner – Partitioner– Searching – Sorting –Compression.

UNIT – III HIVE AND PIG [9]

HIVE: Hive Architecture – Hive Data Types – Hive File Format – HQL– RCFile Implementation – SerDe – UDF. Pig: Pig overview – Anatomy of Pig – Pig on Hadoop – Pig Latin overview–Data types in Pig – Running Pig – Execution Modes of Pig – HDFS Commands – Relational Operators – Eval Function – Complex Data type – UDF – Pig Versus Hive.

UNIT – IV BASIC CONCEPTS OF CLOUD COMPUTING [9]

Introduction to Cloud Computing – Cloud Computing Architecture – Service Management in Cloud Computing – Data Management in Cloud Computing.

UNIT – V CLOUD INFRASTRUCTURE [9]

Resource Management in Cloud – Cloud Security – Open Source and Commercial Clouds – Cloud Simulator – Research trend in Cloud Computing – Fog Computing.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Summarize the systems and mechanisms to support cloud computing
CO2: Comprehend the hardware necessary for cloud computing.
CO3: Realize how to leverage the insights from big data analytics
CO4: Be aware of MongoDB, Cassandra MapReduce Programming and analyze the large dataset.
CO5: Analyze and implement Hive and Pig technology in real time environment.

Text Book :

1 Seema Acharya and Subhashini Chellappan, Big Data and Analytics, Wiley India Pvt. Ltd, India, First Edition, 2015.
2 Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd, India, First Edition, 2011.

Reference Books :

1 Rajkumar Buvyya,C, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw Hill Education(India) Pvt. Ltd, New Delhi, Third Edition, 2013
2 WA Gmob, Big Data and Hadoop, Madhya Pradesh, Kindle Edition, 2013
3 Eric Miller, A Overview of Map Reduce and its impact on Distributed Data, Madhya Pradesh, Kindle Edition, 2012
4 Kristina, MongoDB: The Definitive Guide, O'Reilly, California, Second Edition, 2013.

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18CS871	**M – COMMERCE**	3	0	0	3

Prerequisite: *Basic knowledge of Mobile Communications Systems.*

Objectives:

- *To learn basics of mobile commerce.*
- *To impart knowledge on communication systems, and cellular technology.*
- *To study the concepts of mobile access technology.*
- *To explore various mobile products.*
- *To educate about mobile security and legal aspects.*

UNIT – I FUNDAMENTALS OF MOBILE COMMERCE [9]

Introduction to M-Commerce: Scope – Principles – Benefits and Limitations – Frameworks – Business models – E-Commerce Vs M-Commerce – M-commerce Services: Types M-Commerce Services – NTT DoCoMo i-Mode – Mobile Portal – M-Commerce applications.

UNIT – II MOBILE COMMUNICATION AND CELLULAR TECHNOLOGY [9]

Wireless and Mobile Communication: Communication systems – Wireless communication – Satellite communication – Mobile communication system – Cellular communication – Digital Cellular Technology: Cellular communication – Cellular networks – Mobile phone cellular networks.

UNIT – III MOBILE ACCESS TECHNOLOGY AND DEVICES [9]

Mobile communication standards – Evaluation of mobile communication system. Mobile Devices: Types – Mobile Computers – Mobile Internet Device – Personal Digital Assistant – Mobile Service Providers.

UNIT – IV MOBILE PRODUCTS [9]

Mobile banking: Models – Technologies – Services – Advantages – Challenges and Applications. Mobile ticketing: process – Applications – Privacy and Security Issues – Apps and Providers. Mobile payment: Characteristics – Models – Types – Issues and Service Providers – Challenges of mobile computing – Mobile computing software platforms.

UNIT – V SECURITY AND LEGAL ASPECTS [9]

Security and privacy issues: Concepts – Mechanism – Network security – Information security – Device security – Application security – Mobile security management. Legal Aspects: mobile device related laws – Case study: Mobile shopping – Mobile business intelligence.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Outline the concept of M-commerce Services and applications.
CO2: Acquire knowledge on mobile communication and cellular technology
CO3: Identify different evaluation of mobile communication system.
CO4: Aware of various mobile products and mobile payments.
CO5: Discover the knowledge of Security and Legal Aspects.

Text Book :

1 Karabi Bandyopadhyay, Mobile Commerce, PHI Learning private limited, Delhi, Fourth Edition, 2013.
2 E.Brian Mennecke, J.Troy Strader, Mobile Commerce: Technology, Theory and Applications, Idea Group Inc., IRM press, USA. First Edition, 2003

Reference Books :

1 Ravi Kalakota, B.Andrew Whinston, Frontiers of Electronic Commerce, Pearson Education, Delhi, Fourth Edition, 2007.
2 P. J. Louis, M-Commerce Crash Course, McGraw- Hill Companies, Europe, First Edition, 2001.
3 Paul May, Mobile Commerce: Opportunities, Applications, and Technologies Of Wireless Business Cambridge University Press, England, Second Edition, 2017.
4 textofvideo.nptel.iitm.ac.in/106105084/lec35.pdf

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18CS613	**SOFTWARE TESTING**	3	0	0	3

Prerequisite: *Basic knowledge about Software Engineering.*

Objectives:

- *To learn the criteria for test cases and the knowledge in Selenium.*
- *To make the student to design the test cases.*
- *To gain knowledge in levels of testing.*
- *To know the ideas in test management.*
- *To study about test automation, testing metrics and measurements.*

UNIT – I BASIC CONCEPTS OF SOFTWARE TESTING [9]

Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – Tester‘s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – Introduction to Selenium – Using Selenium IDE for Automation Testing – Using Selenium Web Driver for Automation Testing – Understanding Testing Framework with Selenium Web Driver for Automation Testing.

UNIT – II TEST CASE DESIGN STRATEGIES [9]

Test case Design Strategies – Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – User documentation testing - Requirements based testing – Using White Box Approach to Test design – Test Adequacy Criteria – Static testing vs. structural testing – Code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Code complexity testing.

UNIT – III LEVELS OF TESTING [9]

The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Alpha, Beta Tests – Usability and Accessibility testing – Configuration testing.

UNIT – IV TEST MANAGEMENT [9]

People and organizational issues in testing – Organization structures for testing teams – Testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – Test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group – Structure of Testing Group.

UNIT – V TEST AUTOMATION [9]

Software test automation – skills needed for automation – Scope of automation – Design and architecture for automation – Requirements for a test tool – Challenges in automation – Test metrics and measurements – Project, progress and productivity metrics.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Design test cases suitable for a selenium tool.
CO2: Identify suitable tests to be carried out.
CO3: Prepare test planning based on the requirements.
CO4: Document test plans and test cases designed.
CO5: Use automatic testing tools.

Text Book :

1 Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing Principles and Practices, Pearson Education, India, Sixth Edition, 2008

2 Ron Patton, Software Testing, Sams Publishing, Pearson Education, India, Second Edition, 2007..

Reference Books :

1 Elfriede Dustin, Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality, Addison Wesley, US, First Edition, 2009.

2 http://www.gxsblogs.com/wp-content/blogs.dir/1/files/SEPA-Penalties-Table1.png?8f0a21

3 Selenium.org - http://docs.seleniumhq.org/docs/

4 http://www.seleniumhq.org/download/

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18EC662	**MEDICAL ELECTRONICS**	3	0	0	3

Prerequisite: *-*

Objectives:

- *To learn the methods of recording various bio-potentials.*
- *To understand the design and working of various diagnostic equipments.*
- *To be familiar with the design and working of various therapeutic equipments.*
- *To expose the principles and working behind various imaging techniques.*
- *To gain knowledge about the recent trends in medical instrumentation.*

UNIT - I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING [9]

The origin of bio-potentials - Bio-potential electrodes - Carrier, chopper and isolation amplifiers -Transducers for biomedical applications: Strain gauge, piezoelectric transducer, thermocouple, thermistor, biosensors - ECG, EEG, EMG, PCG, ERG and EOG: Lead systems, recording methods, typical waveforms and signal characteristics.

UNIT - II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT [9]

Blood gas analyzers - Electrophoresis - Colorimeter & Photometer - Auto analyzer - Blood flow meter - Cardiac output - Respiratory measurement - Blood pressure measurement - Temperature measurement - Pulse measurement -Blood cell counters: Coulter counters.

UNIT - III THERAPEUTIC EQUIPMENTS [9]

Cardiac pacemakers - DC defibrillator - Dialyzers - Surgical diathermy - Physiotherapy and electrotherapy equipment - Oxygenators - Heart lung machine.

UNIT - IV MEDICAL IMAGING [9]

X-Ray - Computer Axial Tomography - Positron Emission Tomography - MRI and NMR - Ultrasonic Imaging systems.

UNIT - V RECENT TRENDS IN MEDICAL INSTRUMENTATION [9]

Thermograph - Endoscopy unit - LASER in medicine - Biomedical telemetry - Radio-pill - Cardiac catheterization laboratory - Electrical safety of medical equipment.

Total (L=45 , T= 0) = 45 Periods

Course Outcomes : On Completion of this course, the student will be able to

CO1: Describe the recording methods of various bio-potentials.

CO2: Interpret the working of various equipment that deal with bio-chemical and non-electrical parameter measurement.

CO3: Illustrate different types of therapeutic equipment.

CO4: Demonstrate the principles of various medical imaging modalities.

CO5: Describe the recent trends in medical instrumentation.

Text Books :

1 R.S.Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, Noida, Third Edition, 2014.

2 Leslie Cromwel, Fred J.Weibel, Erich A.Pfeiffer, Biomedical Instrumentation and Measurements, Pearson/Prentice Hall India, Delhi, Second Edition, 2011..

Reference Books :

1 John G.Webster, Medical Instrumentation Application and Design, John Wiley & Sons Inc, United States, Fourth Edition, 2010..

2 Joseph J.Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley &Sons, United States, Fourth Edition, 2008.

3 M. Arumugam, Biomedical Instrumentation, Anuradha Publications, Chennai, Second Edition, Reprint 2009.

4 R.L. Reka & C. Ravikumar, Biomedical Instrumentation/ Medical Electronics, Lakshmi Publications, Chennai, Second Edition, Reprint 2010.

4 S.K. Pillai, A First Course on Electrical Drives, New Age International (P) Ltd., Third Edition, 2018.

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Open Elective

		L	T	P	C
18EE099	**ELECTRICAL WIRING, ESTIMATION AND COSTING** (Common to AU, CE, EC & ME)	3	0	0	3

Prerequisite: *-*

Objectives:

- *To describe the specifications of various wiring accessories.*
- *To describe the materials used for internal wiring and illumination.*
- *To comprehend various wiring systems used in domestic wiring.*
- *To describe the preparation of the estimate and cost of materials used for internal wiring.*
- *To prepare the estimate of wiring materials and cost of wiring for single phase and three phase supplies.*

UNIT - I INTRODUCTION TO WIRING AND PROTECTIVE DEVICES [9]

Wiring accessories- main switch-isolator and load break duty-classification of main switches-functional switches-one way-two way-intermediate switches-knife switches-specification of switches-function and specification of socket outlets, ceiling roses, fan regulators-Fuses-need-classification-Neutral link-Miniature circuit breaker-classification-function and specification.

UNIT - II INTERNAL WIRING SYSTEM AND ILLUMINATION [9]

Design and Drawing of Internal wiring system for various types of Residential, Commercial and Industrial buildings-Electrical layout- Different types of circuits, Light circuit, Power circuit, Sub-main wiring, Main wiring, Single Line diagram-Introduction to Illumination, Nature of light, Different types of Lamps used in Residential, Commercial and Industrial buildings- Lighting schemes.

UNIT - III EXTERNAL WIRING SYSTEM AND EARTHING [9]

Introduction, Different types of Under Ground (UG) Cables- Cable Laying- Electrical Control Panels- Feeder Pillar-External Electrical Distribution System- Single Line Diagram- Load Calculations- General Specifications of Generating Set, Transformer, Circuit Breakers- Street Lighting- Earthing- Different types of earthing system- Plate earthing, Pipe Earthing.

UNIT - IV ESTIMATION OF DOMESTIC INSTALLATION [9]

Selection of cables for internal wiring-cable size calculation- Selection criteria for of control switches-main switch- size of earth continuity conductor and earthing conductor- Preparation of schematic diagrams and wiring diagrams-Single line and multiline- Estimation problems regarding Electrification of domestic buildings –relevant rules regarding electrification of high rise buildings.

UNIT - V ESTIMATION OF INDUSTRIAL INSTALLATIONS [9]

Installation of motor pump set- Estimation problem regarding domestic and irrigation pump sets- Estimation problems in small workshops below 50kW connected load- Service connection- definition-classification-use of weather proof cables - estimation problems for single phase and three phase overhead service connections.

Total (L=45 , T= 0) = 45 Periods

Course Outcomes : On Completion of this course, the student will be able to

CO1: Describe the various wiring materials and protective devices.
CO2: Discuss the internal wiring system and illumination.
CO3: Outline the external wiring system and installations.
CO4: Explain the electrical estimation for domestic installation.
CO5: Describe the electrical estimation details for industrial installation.

Text Books :

1 Raina,K.B. and Bhattacharya, S.K., Electrical Design Estimating and Costing, New Age International, New Delhi, Second Edition, 2017.
2 Gupta, J.B., A Course in Electrical Installation Estimating and Costing, S K Kataria & Sons, New Delhi, Reprint Edition, 2013.

Reference Books :

1 Surjith Singh, Electrical Estimating and Costing, Dhanpat Rai Publishing Company, New Delhi, First Edition, 2016.

2 Uppal, S.L., Electrical Wiring, Estimating and Costing, Khanna Publisher, New Delhi, Sixth Edition, 1987.

3 Soni,P.M. and Upadhyay, P.A., Wiring Estimating Costing & Contracting, Atul Prakashan, Ahmedabad, First Edition, 2017.

4 Bureau of Indian Standards, I.E. rules for wiring, Electricity Supply Act-1948.

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2018**

Open Elective

		L	T	P	C
18EE691	**ELECTRICAL DRIVES AND CONTROL SYSTEMS** (Common to AU & ME)	3	0	0	3

Prerequisite: *Basics of Electrical and Electronics Engineering*

Objectives:

- *To realize the representation of systems and obtain transfer function models.*
- *To provide adequate knowledge in the electrical drive.*
- *To impart the knowledge on the characteristics of drive motors.*
- *To gain the knowledge on solid state DC drive systems.*
- *To provide adequate knowledge on solid state AC drives.*

UNIT - I CONTROL SYSTEMS [9]

Introduction to Control Systems – Types of system: Open and Closed loop systems – Basic elements in control system – Electrical analogous of mechanical translational and rotational system, Thermal system – Transfer function – Block diagram reduction techniques – Signal flow graphs – P, PI, PID controllers.

UNIT - II INTRODUCTION TO ELECTRICAL DRIVES [9]

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT - III DRIVE MOTOR CHARACTERISTICS [9]

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors.

UNIT - IV SOLID STATE DC DRIVES [9]

Speed control of DC series and shunt motors: Armature and field control, Ward-Leonard control system – Speed control using controlled Rectifiers and DC choppers – Applications.

UNIT - V SOLID STATE AC DRIVES [9]

Speed control of three phase induction motor: Voltage control, voltage / frequency control, slip power recovery scheme – Speed control using inverters and AC voltage regulators – Applications.

Total (L=45, T= 0) = 45 Periods

Course Outcomes : On Completion of this course, the student will be able to

CO1: Obtain the transfer function of electrical and mechanical systems.

CO2: Describe the various types of drive system and its selection criteria.

CO3: Explain the electrical and mechanical characteristics of drive motors.

CO4: Outline the solid state DC drive and its applications.

CO5: Discuss the solid state AC drive and its applications.

Text Books :

1 J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Pvt Ltd, New Delhi, Sixth Edition, 2017.

2 Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi, Second Edition, 2010.

Reference Books :

1 I.J.Nagrath and D.P. Kothari, Electrical Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, 2006.

2 Vedam Subrahmaniam, Electric Drives (Concepts and Applications), Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2011.

3 Bimal K. Bose, Modern Power Electronics and AC Drives, Prentice-Hall of India Pvt. Ltd., New Delhi, First Edition, 2001.

4 S.K. Pillai, A First Course on Electrical Drives, New Age International (P) Ltd., New Delhi, Third Edition, 2018.

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Open Elective

		L	T	P	C
18EE868	**ELECTRONIC INSTRUMENTATION** (Common to AU, CE, EC, EE & ME)	3	0	0	3

Prerequisite: *Electric Circuit Analysis, Analog Electronics, Measurements and Instrumentation*

Objectives:

- *To introduce different types of electronic meters and their applications.*
- *To educate on various Digital instruments and its applications.*
- *To provide knowledge on various types of cathode ray oscilloscopes and signal analyzers.*
- *To impart knowledge about different types of waveform generators.*
- *To give exposure to telemetry, modulation techniques and multiplexing.*

UNIT - I ELECTRONIC INSTRUMENTS [9]

Introduction – Functional elements of a measurement system – Electronic Voltmeter and their advantages – Types: Differential amplifier, rectifier, multirange – True RMS voltmeter – Ohmmeter – Electronic multimeter – Current measurement – Power measurement – Microprocessor based DMM with auto ranging and self-diagnostic features.

UNIT - II DIGITAL INSTRUMENTS [9]

Digital Voltmeter, Types: Ramp, Integrating and Dual slope – Digital Multimeter – Digital Frequency meter – Digital Time Measurement – Digital Tachometer and pH meter – Automation in digital instruments – Microprocessor based instruments.

UNIT - III CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS [9]

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

UNIT - IV WAVEFORM GENERATORS [9]

Wien's bridge and phase shift oscillators – Hartley and crystal oscillators – Square wave and pulse generators – Triangular wave-shape generator – Signal and function generators – Q meter – Electronic Counters.

UNIT - V TELEMETRY [9]

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing.

Total (L=45, T= 0) = 45 Periods

Course Outcomes : On Completion of this course, the student will be able to

CO1: Explain different types of electronic meters and their applications.

CO2: Describe various Digital instruments and its applications.

CO3: Explain the working of various types of cathode ray oscilloscopes and signal analyzers.

CO4: Discuss the functional operation of different types of waveform generators.

CO5: Outline the principle of telemetry, modulation techniques and multiplexing.

Text Books :

1 Kalsi, H.S., Electronic Instrumentation, Tata McGraw-Hill, New Delhi, Second Edition, 2019.

2 Helfrick, A.D. and Cooper, W.D., Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, First Edition, 2013.

Reference Books :

1 David A Bell, Electronic Instrumentation and Measurements, Oxford University Press, London, Third Edition, 2013.

2 Prithiwiraj Prukait, Budhaditya Biswas, Santanu Das and Chiranjib Koley, Electrical and Electronics Measurement and Instrumentation, Tata McGraw Hill, New Delhi, First Edition, 2013.

3 J J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, Third Edition, 2011.

4 Sawhney, A.K., Electrical, Electronic measurement & Instrumentation, Dhanpat Rai & sons, New Delhi, Eighteenth edition, 2012.

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Open Elective

		L	T	P	C
18EE711	**EMBEDDED SYSTEMS** (Common to AU, CS, EE & ME)	3	0	0	3

Prerequisite: *Microprocessor and Microcontroller*

Objectives:

- *To learn and understand the fundamental concept of embedded systems.*
- *To Study the embedded networks.*
- *To understand the concepts of software development Process.*
- *To understand the functions of RTOS.*
- *To learn system design concepts.*

UNIT - I INTRODUCTION TO EMBEDDED SYSTEMS [9]

Embedded System Vs General Computing System – Classification of embedded systems – Functional building blocks of embedded systems – Structural units in embedded processor – Selection of processor & memory devices – Processor interfacing with memory and I/O units – Embedded hardware units – PIC16F877A: Architecture – Instruction set.

UNIT - II EMBEDDED NETWORKS [9]

Introduction to I/O device ports & buses – Serial communication using I^2C,CAN,SPI,USB and PROFI buses – Parallel communication using PCI,PCI-X buses, ARM bus – Internet enabled systems – Wireless and mobile system protocols.

UNIT - III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT [9]

Introduction to embedded software development process and tools – Host and target machines – linking and locating software – Embedded Product Development Life Cycle – objectives, different phases of EDLC, Modeling of EDLC – Fundamental issues in hardware and software Co-design – Data Flow Graph – state machine model.

UNIT - IV REAL TIME OPERATING SYSTEMS [9]

Introduction to basic concepts of RTOS – Task, process & threads – Context switching – Multiprocessing and Multitasking – Preemptive and nonpreemptive scheduling – Round Robin scheduling – Task communication – shared memory, message passing – Interprocess communication – semaphores, Message queue, Mailbox, pipes – priority inversion – priority inheritance.

UNIT - V RTOS BASED EMBEDDED SYSTEM DESIGN [9]

Basic Functions and Types of RTOS – Interrupt routines in RTOS – Case Study of Washing Machine – Automotive Application – Smart card system – ATM machine – Digital camera.

Total (L=45 , T=0) = 45 Periods

Course Outcomes : On Completion of this course, the student will be able to

CO1: Illustrate the fundamentals of embedded systems.

CO2: Outline the various types of embedded communication protocols.

CO3: Explain the concept of software development process and tools.

CO4: Describe the functions of real time operating systems.

CO5: Apply the knowledge of embedded product development.

Text Books :

1 Rajkamal.P. Embedded System – Architecture, Programming, Design, Tata McGraw Hill Education Private Limited, New Delhi, Third Edition, 2016.

2 John B.Peatman, Design With PIC microcontroller, Pearson Education, India, First Edition, 2009.

Reference Books :

1 Frank Vahid and Tony Givargi, Embedded System Design - A Unified Hardware & Software Introduction, John Wiley, New Jersey, Third Edition, 2011.

2 David E.Simon, An Embedded software primer, Pearson Education, India, First Edition, 2007.

3 Steve Heath, Embedded System Design, Elsevier, India, Second Edition, 2003.

4 Wayne wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufmann publishers, USA, Third Edition, 2012.

R 2018

K.S.R. COLLEGE OF ENGINEERING (Autonomous)

Open Elective

18IT563	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

Prerequisite: *Computer Networks*

Objectives:

- *To understand the basic concepts of mobile computing*
- *To be familiar with the network protocol stack*
- *To learn the basics of mobile telecommunication system*
- *To be exposed of Ad-Hoc networks*
- *To know about different mobile platforms and application development.*

UNIT – I INTRODUCTION [9]

Mobile Computing - Mobile Computing vs. wireless Networking - Mobile Computing Applications - Characteristics of Mobile computing - Structure of Mobile Computing Application. MAC Protocols - Wireless MAC Issues - Fixed Assignment Schemes - Random Assignment Schemes - Reservation Based Schemes

UNIT – II MOBILE TELECOMMUNICATION SYSTEM [9]

Global System for Mobile Communication (GSM) - General Packet Radio Service (GPRS) - Universal Mobile Telecommunication System (UMTS)

UNIT – III MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER [9]

Overview of Mobile IP - Features of Mobile IP - Key Mechanism in Mobile IP - route Optimization. Overview of TCP/IP – Architecture of TCP/IP - Adaptation of TCP Window - Improvement in TCP Performance

UNIT – IV MOBILE AD-HOC NETWORKS [9]

Ad-Hoc Basic Concepts – Characteristics - Applications - Design Issues - Routing - Essential of Traditional Routing Protocols -Popular Routing Protocols - Vehicular Ad Hoc networks (VANET) - MANET vs. VANET - Security

UNIT – V MOBILE PLATFORMS AND APPLICATIONS [9]

Mobile Device Operating Systems - Special Constrains & Requirements - Commercial Mobile Operating Systems – Software Development Kit: iOS – Android - BlackBerry - Windows Phone - MCommerce - Structure - Pros & Cons - Mobile Payment System -Security Issues

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

C01: Gain knowledge on basic concept of the mobile networks

C02: Explore knowledge on Mobile IP and TCP

C03: Explain Mobile Telecommunication System

C04: Learn about Mobile Ad-hoc Networks

C05: Know about Mobile platform and applications

Text Book :

1 Prasant Kumar Pattnaik, Rajib Mal, Fundamentals of Mobile Computing, PHI Learning Pvt. Ltd, New Delhi ,2016

2 Jochen H. Schller, Mobile Communications, Second Edition, Pearson Education, New Delhi, 2007

Reference Books :

1 Dharma Prakash Agarval, Qing and An Zeng, Introduction to Wireless and Mobile systems, Thomson Asia Pvt Ltd, 2005

2 Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, Principles of Mobile Computing, Springer, 2003

3 William.C.Y.Lee, Mobile Cellular Telecommunications, Analog and Digital Systems, Second Edition,Tata Mc Graw Hill Edition,2006

4 Android Developers : http://developer.android.com/index.html

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Open Elective

		L	T	P	C
18ME777	**HYDRAULICS AND PNEUMATICS**	3	0	0	3

Prerequisite: *Fluid Mechanics and Machinery*

Objectives:

- *To obtain the knowledge on fundamentals of fluid power system.*
- *To classify the types, performance study of pumps and actuators in fluid power systems.*
- *To categorize different types of hydraulic, pneumatic valves & servo valves.*
- *To build up the hydraulic and pneumatic circuits of simple industrial application.*
- *To identify the fluidic devices and PLC application in fluid power system.*

UNIT – I FLUID POWER SYSTEMS AND FUNDAMENTALS [9]

Fluids - compressible, incompressible - properties - introduction to fluid power systems - types, advantages, applications - fluid power symbols. Pascal's law - laminar and turbulent flow - Reynolds's number - Darcy's equation - losses in pipes, valves and fittings.

UNIT – II PUMPS AND ACTUATORS [9]

Pumping theory - positive, non positive displacement pumps - fixed, variable displacement pumps - gear pump, vane pump, piston pump - pump performance. Actuators - linear hydraulic actuators - types of hydraulic cylinders - single acting, double acting, special cylinders like tandem, rod less, telescopic, cushioning mechanism. Rotary actuators - fluid motors, gear, vane, piston motors.

UNIT – III DESIGN OF HYDRAULIC CIRCUITS [9]

Types of valves - direction control - 3/2, 4/2 valves, shuttle valve, check valve. Pressure control - pressure reducing valve, sequence valve. Flow control - fixed, adjustable. Controls - manual, solenoid, pilot, relays. Accumulators - types, circuits, sizing. Intensifier - intensifier circuits - meter-in, meter-out circuits.

UNIT – IV PNEUMATIC SYSTEM AND CIRCUITS [9]

Properties of air - pneumatic components - compressors, filters, regulators, lubricators and control valves, quick exhaust valves, pneumatic actuators. Fluid power circuit design - speed control circuit, synchronizing circuit, sequential circuit for simple applications using cascade method - pneumo - hydraulic circuit.

UNIT – V ADVANCED FLUID POWER SYSTEMS [9]

Servo systems - hydro mechanical servo systems, electro hydraulic servo systems, proportional valves. Fluidics - introduction to fluidic devices, simple circuits, introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Troubleshooting in fluid power circuits.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

C01: Explore the working principles of fluid power system.

C02: Recognize the types, performance of pumps and actuator in fluid power systems.

C03: Demonstrate the different types of hydraulic, pneumatic valves & servo valves.

C04: Analyze the hydraulic and pneumatic circuits of simple industrial application.

C05: Categorize the fluidic devices and PLC application in fluid power system..

Text Book :

1 Srinivasan R, Hydraulic and Pneumatic Controls, TMH, Delhi, Second Edition, 2011.

2 Anthony Esposito, Fluid Power with Applications, Pearson Education, Delhi, Second Edition, 2009.

Reference Books :

1 Majumdar S.R., Pneumatic systems - Principles and Maintenance, Tata McGraw Hill, Delhi, Second Edition, 1996.

2 Majumdar S.R., Oil Hydraulics, Tata McGraw-Hill, Delhi, Third Edition, 2011.

3 Shanmugasundaram K, Hydraulic and Pneumatic Controls, Chand & Co, Delhi, Third Edition, 2019.

4 Dudley A. Pease and John T. Pippenger, Basic Fluid Power, Prentice Hall, Delhi, Second Edition, 1987.

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Open Elective

		L	T	P	C
18ME564	**POWER PLANT ENGINEERING**	3	0	0	3

Prerequisite: *Engineering Thermodynamics and Thermal Engineering*

Objectives:

- *To explore the layout and main components of steam power plant.*
- *To acquire knowledge of diesel and gas turbine power plants.*
- *To comprehend nuclear power plant layout and its components.*
- *To study the typical layouts of renewable energy power plants.*
- *To compare economics of various power plants.*

UNIT – I STEAM POWER PLANT [9]

Layout and types of Steam Power Plants – Steam Boilers – Fuel and Ash handling systems – combustion equipment for burning coal – Mechanical stokers – Pulverizers – Electrostatic precipitator – Draught – different types, Surface condenser types, Cooling towers, Pollution Controls.

UNIT – II DIESEL AND GAS TURBINE POWER PLANTS [9]

Layout and types of Diesel power plants and components, selection of engine type, applications. Gas Turbine power plant – Layout - Fuels, gas turbine material, types of combustion chambers - reheating, regeneration and inter - cooling.

UNIT – III NUCLEAR POWER PLANT [9]

Nuclear energy - Fission, Fusion reaction - Layout of nuclear power plants - Types of reactors, pressurized water reactor - Boiling water reactor - Gas cooled reactor - Fast breeder reactor - Waste disposal and safety.

UNIT – IV RENEWABLE ENERGY POWER PLANTS [9]

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Geo Thermal, Biogas power systems.

UNIT – V POWER PLANT ECONOMICS [9]

Economics of power plant – Actual load curves-cost of electric energy-fixed and operating costs-energy rates – Types of Tariffs – Economics of load sharing – variable load operation - comparison of economics of various power plants.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Design the plant Layout for steam power plant and its components.

CO2: Identify the diesel and gas turbine power plant Layouts.

CO3: Explore the nuclear power plant layouts and reactors.

CO4: Gain knowledge on renewable energy power plants.

CO5: Evaluate the economic factors of various power plants.

Text Book :

1 Arora S.C. and Domkundwar.S.,A Course in Power Plant Engineering, Dhanpatrai, New Delhi, Second Edition, 2019.

2 Nag P.K., Power Plant Engineering, Tata-McGraw Hill, New Delhi, Second Edition, 2019.

Reference Books :

1 Frank D.Graham, Power Plant Engineers Guide, D.B. Taraporevala Sons &Co., New Delhi, Second Edition,2010

2 T.Morse Frederick, 'Power Plant Engineering', Prentice Hall of India, 2014.

3 R.K.Rajput, Power Plant Engineering, Laxmi Publications, Chennai, Fourth Edition, 2016.

4 El-Wakil. M.M., Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., New Delhi, Second Edition, 2010.

5 G.D.Rai, Introduction to Power Plant Technology, Khanna Publishers, New Delhi, Third Edition, 1995.

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Open Elective

		L	T	P	C
18ME712	**MECHATRONICS**	3	0	0	3

Prerequisite: *Electronics and Microprocessor, Hydraulics and pneumatics.*

Objectives:

- *To study the various components of mechatronics, measurement and control systems.*
- *To apply mechanical actuation systems for hydraulic and electric systems.*
- *To model control systems for mechanical and electromechanical systems.*
- *To identify suitable PLC for mechatronics systems.*
- *To design a microprocessor based control system for machinery.*

UNIT – I MECHATRONICS , SENSORS AND TRANSDUCERS [9]

Introduction to mechatronics systems - measurement systems - control systems - microprocessor based controllers. Sensors, transducers - performance terminology - sensors for displacement, position, proximity, velocity, force, fluid pressure, liquid flow, liquid level, temperature, light sensor-selection of sensor.

UNIT – II ACTUATION SYSTEMS [9]

Pneumatic hydraulic systems - directional control valves - rotary actuators. Mechanical actuation systems - cams - gear train - ratchet and pawl - belt and chain drives - bearing electrical actuation systems -mechanical switches - solid state switches - solenoids - construction and working principle of AC and DC motors - speed control of AC and DC drives, stepper motors - switching circuitries for stepper motor - AC and DC servo motors.

UNIT – III SYSTEM MODELS AND CONTROLLERS [9]

Building blocks of mechanical, electrical, fluid and thermal systems, rotational-translational systems, electromechanical systems - hydraulic-mechanical systems. Continuous and discrete process controllers -control mode - two-step mode - proportional mode - Derivative mode-Integral mode - PID controllers-digital controllers - velocity control - adaptive control - digital logic control.

UNIT – IV PROGRAMMABLE LOGIC CONTROLLERS [9]

Basic structure - input/output processing-programming - mnemonics - timers, internal relays , counters - shift registers - master and jump controls - data handling - analog input/output - selection of a PLC.

UNIT – V DESIGN OF MECHATRONICS SYSTEMS [9]

Stages in designing mechatronics systems - traditional, possible design solutions. Case studies of mechatronics systems - pick and place robot - autonomous mobile robot - wireless surveillance balloon - engine management systems.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify appropriate sensors and transducers to control mechatronics systems.

CO2: Demonstrate suitable actuator for mechanical and electrical drives.

CO3: Model control systems for electro mechanical systems.

CO4: Analyze PLC program for mechatronics systems.

CO5: Formulate a automated mechatronics system management control.

Text Book :

1 Bolton.W, Mechatronics, Pearson education, New Delhi, second Edition, 2017.

2 Rajput.R.K., A text book of Mechatronics, S. Chand and Co, Delhi, Second Edition, 2018.

Reference Books :

1 Nitaigor Premchand Mahadik., Mechatronics, Tata McGraw-hill publishing company Ltd, New Delhi, Second Edition, 2007.

2 David G. Alciatore Michael B. Histand., Introduction to mechatronics and measurement system, TMH, Delhi, Second edition, 2019.

3 Michael.B.histand and David G. Alciatore, Introduction to mechatronics systems , TMH, Delhi, Second edition, 2018.

4 Dan necsulesu, Mechatronics, Pearson education Asia, Delhi, Second Edition, 2002.

5 http://nptel.ac.in

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Open Elective

		L	T	P	C
18ME774	**FUNDAMENTALS OF NANO SCIENCE**	3	0	0	3

Prerequisite: *Applied Physics*

Objectives:

- *To study the impact of engineering solutions using Nano science and technology.*
- *To classify the preparation methods of Nano materials.*
- *To utilize the patterning and lithography techniques.*
- *To extend the preparation environment of Nano materials and their hazards.*
- *To apply characterization techniques for analyzing the material behaviour.*

UNIT – I INTRODUCTION [9]

Nano science and technology - implications on physics, chemistry, biology and engineering -classifications of nano structured materials - nano particles - quantum dots, wells and wires. Ultra-thin films - multilayered material. Properties: mechanical, electronic, optical, magnetic and motivation for study (qualitative only).

UNIT – II PREPARATION METHODS [9]

Bottom-up and top-down approach: mechanical milling, colloidal routes, self assembly, vapour phase deposition, MOCVD, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy, MOMBE, Sol-gel technique.

UNIT – III PATTERNING AND LITHOGRAPHY [9]

Introduction to optical /UV electron beam and X RAY lithography systems and processes, wet etching, dry (plasma/reactive ion) etching, etch resists - dip pen lithography, nano imprint lithography and soft lithography.

UNIT – IV PREPARATION ENVIRONMENT AND HAZARDS [9]

Clean rooms: specifications and design, air and water purity, requirements for particular processes, vibration free environments: services and facilities required. Working practices, sample cleaning, chemical purification, chemical and biological contamination, safety issues, flammable and toxic hazards and bio-hazards.

UNIT – V CHARACTERISATION TECHNIQUES [9]

Introduction to mechanical characterization. Optical microscopy - AFM, SPM, STM, SNOM, ESCA, SIMS, XRD, SEM, TEM.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the impact of engineering solutions using Nano science and technology.

CO2: Categorize the preparation methods of Nano materials.

CO3: Apply the patterning and lithography techniques.

CO4: Develop a preparation environment of Nano materials and their hazards.

CO5: Explore characterization techniques for analyzing the material behaviour.

Text Book :

1 The Oxford hand book of Nano science and technology, edited by A.V.Narlivar, 2018.

2 Encyclopedia of Nano technology, Elwood D.Carlson , 2018.

Reference Books :

1 Akhlesh Lakhtakia, The Hand Book Of Nano-technology, New Delhi, Second Edition, 2017.

2 N John Dinardo, Nano-scale Characterization Of Surfaces And Interfaces, Weinheim Cambridge, Willy-VCH, UK, Second Edition, 2012.

3 Gregory.C.Timp, Nano-technology, Aip Press/Springer, 1999.

4 A.S Edelstein And R.C Cammearata, Eds, Nano-materials; synthesis, properties and application, institute of physics publishing, Bristol and Philadelphia, Second Edition, 1996.

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Open Elective

		L	T	P	C
18HS001	**PRINCIPLES OF MANAGEMENT** (Common to All Branches)	3	0	0	3

Prerequisite: -

Objectives:

- *To explain the historical background and fundamentals of management thought.*
- *To discuss about various concepts of planning.*
- *To describe the various concepts of Organizational structure.*
- *To illustrate the various management leadership concepts.*
- *To develop the emerging concepts of management though and philosophy*

UNIT – I OVERVIEW OF MANAGEMENT [9]

Definition of Management – Importance of management – Management functions – Levels of management – Role of managers – Management a science or an art – Evolution of Management thought: Scientific management and Administrative Principles of management – Ethical issues in Management.

UNIT – II PLANNING [9]

Planning: Meaning, purpose, Steps and Types of Plans - Management by objectives (MBO) – Decision Making: Types of Decisions, Steps in Rational Decision making, Common difficulties in Management Decision Making.

UNIT – III ORGANISING [9]

Nature and purpose of organizing : Organization structure, Process and Principles of organizing – Line & Staff authority – Departmentation – Span of Control – Centralization and Decentralization – Delegation of authority – Staffing : Sources of Recruitment, Selection process – Training methods – Performance appraisal methods.

UNIT – IV DIRECTING [9]

Creativity and Innovation – Motivation and Satisfaction: Motivation Theories – Leadership: Leadership theories and Styles – Communication: Barriers to communication, Principles of effective Communication

UNIT – V CONTROLLING [9]

Steps in a control Process: Need for control system, Budgetary and Non-Budgetary control techniques, Problems of the control system, Essentials of effective control system, and Benefits of control.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the fundamentals of Management thoughts and the conceptual frame work of Management

CO2: Discuss the various concepts of planning, MBO and Strategy to help solving managerial problems

CO3: Explain the concepts of organizing, Delegation and Decision making.

CO4: Describe the management concepts and styles in Leading.

CO5: Illustrate the various controlling and emerging concepts in management thought and philosophy

Text Book :

1 L.M.Prasad, Principles and Practices of Management, Sultan Chand & Sons, New Delhi, Eleventh Edition, 2015.

2 P.C.Tripathi and Reddy Principles of Management, McGraw Hill , New Delhi, Eighth Edition, 2015.

Reference Books :

1 Hellriegel, Slocum & Jackson, Management A Competency Based Approach, Thomson South Western, London, Fifteenth Edition, 2017.

2 Harold Koontz, Heinz Weihrich and mark V Cannice, Management – A Global Entrepreneurial Perspective, Tata McGraw Hill, New Delhi, Twelveth Edition, 2014.

3 Andrew J. Dubrin, Essentials of Management, Thomson South western, London, Tenth edition, 2014.

4 Robbins S.P., Fundamentals of Management, Pearson, New Delhi, Second Edition, 2003.