KUMARAGURU COLLEGE OF TECHNOLOGY

(An autonomous Institution affiliated to Anna University, Chennai)

COIMBATORE – 641 049

B.E., AUTOMOBILE ENGINEERING

REGULATION 2017

CURRICULUM AND SYLLABUS

I to VIII Semesters

DEPARTMENT OF AUTOMOBILE ENGINEERING

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DEPARTMENT OF AUTOMOBILE ENGINEERING

Vision

To be a renowned Learning Centre in the field of Automobile Engineering contributing towards development of the society.

Mission

- Develop students for successful careers in Industry, and Academia.
- Provide required learning environment and processes to become socially responsible Engineering Professionals.
- Establish Industry-Institute interaction.
- Inculcate the entrepreneurial mind set among the students.

Program Educational Objectives (PEO's)

Graduates will be able to

1. Design and develop products, utilize their knowledge and skills as engineer / start their own ventures as entrepreneurs
2. Practice managerial leadership roles with values and social responsibility.
3. Pursue higher studies and research in core, allied fields and management.

Program Outcomes (PO's)

The following are the program outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

Graduates will be able to

PSO 1: provide solutions for designing safe and affordable automotive and mobile equipment.

PSO 2: explore the Automotive Manufacturing, Automotive Electrical & Electronics, vehicle maintenance and service domains.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

B.E., AUTOMOBILE ENGINEERING

CURRICULUM- REGULATION- 2017

SEMESTER-I

Course Code	Course Title	Course category	Course Mode	L	T	P	PJ	C
U17ENI1201	English for Cognizance	HS	Embedded	1	0	2	0	**2**
U17MAT1101	Linear Algebra and Calculus	BS	Theory	3	1	0	0	**4**
U17PHT1002	Physics for Automobile Engineering	BS	Theory	3	0	0	0	**3**
U17CHT1001	Chemistry for Automobile Engineering	BS	Theory	3	0	0	0	**3**
U17MET1101	Engineering Graphics	ES	Theory	2	2	0	0	**3**
U17CSI1211	Structured Programming using C	ES	Embedded	3	0	2	0	**4**
U17PHP1501	Physics Laboratory	BS	Lab	0	0	2	0	**1**
U17MEP1501	Engineering Practices Laboratory	ES	Lab	0	0	2	0	**1**
U17VEP1501	Personal Values	HS	Lab	0	0	2	0	**1**
Total Credits								**22**
Total Periods per week								**28**

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SEMESTER-II

Course Code	Course Title	Course category	Course Mode	L	T	P	PJ	C
U17ENE___	Language Electives	HS	Lab	0	0	4	0	**2**
U17MAT2101	Advanced Calculus and Laplace Transforms	BS	Theory	3	1	0	0	**4**
U17PHT2002	Material Science for Automobile Engineering	BS	Theory	3	0	0	0	**3**
U17CHT2001	Metallurgical Chemistry for Automobile	BS	Theory	3	0	0	0	**3**
U17MET2102	Engineering Mechanics	ES	Theory	3	1	0	0	**4**
U17EET2013	Introduction to Electrical and Electronics Engineering	ES	Theory	3	0	0	0	**3**
U17CHP2501	Chemistry Laboratory	BS	Lab	0	0	2	0	**1**
U17EEP2511	Electrical and Electronics Engineering Lab	ES	Lab	0	0	2	0	**1**
U17VEP2502	Inter-Personal values	HS	Lab	0	0	2	0	**1**
U17ISR2001	Social Immersion Project	ES	Project	0	0	0	4	**2**
Total Credits								**24**
Total Periods per week								**31**

SEMESTER 3

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17MAT3101	Partial Differential Equations and Transforms	Theory	BS	3	1	0	0	4	Nil
2	U17AUI3201	Automotive Chassis and Transmission	Embedded - Theory & Lab	PC	3	0	2	0	4	Nil
3	U17AUI3202	Strength of Materials	Embedded - Theory & Lab	PC	3	0	2	0	4	Nil
4	U17AUI3203	Manufacturing Technology	Embedded - Theory & Lab	PC	3	0	2	0	4	Nil
5	U17AUT3104	Thermodynamics and Thermal Engineering	Theory	ES	3	1	0	0	4	Nil
6	U17INI3600	Engineering Clinic I	Embedded - Practical & Project	ES	0	0	4	2	3	Nil
Total Credits									**23**	
Total Contact Hours/week									**29**	

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SEMESTER 4

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17MAT4101	Numerical Methods and Probability	Theory	BS	3	1	0	0	**4**	Nil
2	U17AUI4201	Automotive Engines and Systems	Embedded - Theory & Lab	PC	3	0	2	0	**4**	U17AUT3104
3	U17AUI4202	Fluid Mechanics and Machinery	Embedded - Theory & Lab	PC	3	0	2	0	**4**	Nil
4	U17AUI4203	Machine Drawing	Embedded - Theory & Lab	PC	3	0	2	0	**4**	Nil
5	U17AUT4004	Vehicle Body Engineering	Theory	PC	3	0	0	0	**3**	Nil
6	U17INI4600	Engineering Clinic II	Embedded - Practical & Project	ES	0	0	4	2	**3**	U17INI3600
Total Credits									**22**	
Total Contact Hours/week									**28**	

SEMESTER 5

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUI5201	Automotive Electrical and Electronics Engineering	Embedded - Theory & Lab	PC	3	0	2	0	**4**	Nil
2	U17AUI5202	Finite Element Analysis	Embedded - Theory & Lab	PC	3	0	2	0	**4**	U17MAT4101
3	U17AUT5103	Design of Machine Elements	Theory	PC	3	1	0	0	**4**	U17AUI3202
4	U17AUT5104	Mechanics of Machines	Theory	PC	3	1	0	0	**4**	Nil
5	U17____	Open Elective I	Theory	OE	3	0	0	0	**3**	Nil
6	U17INI5600	Engineering Clinic III	Embedded - Practical & Project	ES	0	0	4	2	**3**	U17INI4600
Total Credits									**22**	
Total Contact Hours/week									**27**	

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SEMESTER 6

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUI6201	Automotive Embedded Systems	Embedded - Theory & Lab	PC	3	0	2	0	**4**	U17AUI5201
2	U17AUI6202	Vehicle Dynamics	Embedded - Theory & Lab	PC	3	0	2	0	**4**	U17AUT5104
3	U17AUT6003	Hybrid and Electric Vehicles	Theory	PC	3	0	0	0	**3**	U17AUI5201
4	U17AUT6004	Total Quality Management and Project Management	Theory	HS	3	0	0	0	**3**	Nil
5	U17AUE__	Professional Elective - I	Theory	PE	3	0	0	0	**3**	Nil
6	U17___	Open Elective - II	Theory	OE	3	0	0	0	**3**	Nil
7	U17INI6600	Engineering Clinic IV	Embedded - Practical & Project	ES	0	0	4	2	**3**	U17INI5600
Total Credits									**23**	
Total Contact Hours/week									**28**	

SEMESTER 7

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUI7201	Vehicle Maintenance and Reconditioning	Embedded - Theory & Lab	PC	2	0	2	0	**3**	U17AUI3201
2	U17AUT7002	Automotive Emissions	Theory	PC	3	0	0	0	**3**	U17AUI5201, U17AUI4201
3	U17AUE__	Professional Elective - II	Theory	PE	3	0	0	0	**3**	Nil
4	U17AUE__	Professional Elective - III	Theory	PE	3	0	0	0	**3**	Nil
5	U17AUE__	Professional Elective - IV	Theory	PE	3	0	0	0	**3**	Nil
6	U17AUP7703	Project Work - Phase I	Project only Course	PW	0	0	0	6	**3**	--
Total Credits									**18**	
Total Contact Hours/week									**22**	

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SEMESTER 8

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUP8701	Project Work - Phase II	Project only Course	PW	0	0	0	24	12	--
								Total Credits	**12**	
								Total Contact Hours/week	**24**	

Total Credits	**166**

List of mandatory courses					
S.No	**Couse Code**	**Course Title**	**Course Mode**	**CT**	**Semester**
1	U17VEP3503	Family Values	Lab	HS	3
2	U17CHT3000	Environmental Science and Engineering	Theory	MC	3
3	U17VEP4504	Professional Values	Lab	HS	4
4	U17INT4000	Constitution of India	Theory	MC	4
5	U17VEP5505	Social Values	Lab	HS	5
6	U17VEP6506	National Values	Lab	HS	6
7	U17VEP7507	Global Values	Lab	HS	7

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PROFESSIONAL ELECTIVES

Automotive Design

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUE0001	Design of Engine Components	Theory	PE	3	0	0	0	**3**	U17AUI3202 U17AUI4201 U17AUT5103
2	U17AUE0002	Design of Chassis Components	Theory	PE	3	0	0	0	**3**	U17AUI3201 U17AUI3202
3	U17AUE0003	Computational Fluid Dynamics	Theory	PE	3	0	0	0	**3**	U17AUI4202
4	U17AUE0004	Computer Simulation of IC Engine Processes	Theory	PE	3	0	0	0	**3**	U17AUI4201 U17AUT3104

Automotive Manufacturing

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUE0005	Automotive Components Manufacturing	Theory	PE	3	0	0	0	**3**	U17AUI3203
2	U17AUE0006	Design for Manufacture and Assembly	Theory	PE	3	0	0	0	**3**	U17AUI3203
3	U17AUE0007	Composite Materials and Structures	Theory	PE	3	0	0	0	**3**	Nil
4	U17AUE0008	Additive Manufacturing and Tooling	Theory	PE	3	0	0	0	**3**	Nil

Automotive Electrical and Electronics

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUE0009	Automotive Control System	Theory	PE	2	0	2	0	**3**	U17AUI6201
2	U17AUE0010	Auxiliary Vehicle Systems	Theory	PE	3	0	0	0	**3**	Nil
3	U17AUE0011	Fuel Cell Technology	Theory	PE	3	0	0	0	**3**	Nil
4	U17AUE0012	Automotive Communication Protocols	Theory	PE	3	0	0	0	**3**	Nil
5	U17AUE0013	Intelligent Vehicle Technology	Theory	PE	3	0	0	0	**3**	Nil

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Automotive Technology and Management

S.No	Course Code	Course Name	Course Mode	CT	L	T	P	J	C	Pre-requisite
1	U17AUE0014	Off Road Vehicles	Theory	PE	3	0	0	0	**3**	Nil
2	U17AUE0015	Tyre Technology	Theory	PE	3	0	0	0	**3**	Nil
3	U17AUE0016	Vehicle Testing and Validation	Theory	PE	3	0	0	0	**3**	Nil
4	U17AUE0017	Entrepreneurship Development	Theory	PE	3	0	0	0	**3**	Nil
5	U17AUE0018	Vehicle Transport Management	Theory	PE	3	0	0	0	**3**	Nil
6	U17AUE0019	Applied Hydraulics and Pneumatics	Theory	PE	3	0	0	0	**3**	U17AUI4202
7	U17AUE0020	Automotive Aerodynamics	Theory	PE	3	0	0	0	**3**	U17AUI4202

ONE CREDIT COURSES

S.No	Course Code	Course Name
1	U17AUC0001	Motorsports Engineering
2	U17AUC0002	Automotive Styling
3	U17AUC0003	Electronic Engine Management Systems
4	U17AUC0004	Intellectual Property Rights
5	U17AUC0005	Vehicle Maintenance
6	U17AUC0006	Lean Manufacturing

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Semester 1

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U17ENI1201 **ENGLISH FOR COGNIZANCE**

L	T	P	J	C
1	0	2	0	2

(Common to all branches of Engineering and Technology)

Course Outcomes:

After the course the Student will be able to:

CO1: Understand and appreciate vocabulary and syntax with accuracy and clarity.

CO2: Communicate effectively by using appropriate grammar and technical parlance in a range of academic scenarios.

CO3: Interpret and critically evaluate discourses related to functional English.

CO4: Comprehend critical text leading to academic articulation.

CO5: Disseminate professional information through appropriate means of communication.

CO6: Demonstrate an understanding for innovative language learning strategies and write texts applying registers formats and language appropriate to the context.

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				M		S	M		M	S	S	M		
CO2				M		S	M		M	S	S	M		
CO3				M		S	M		M	S	S	M		
CO4				M		S	M		M	S	M	M		
CO5				M		S	M		M	S	M	M		
CO6				M		S	M		M	S	M	M		

Course Assessment methods

Direct	Indirect
1.Continuous Assessment 2.Cooperative learning 3.Assignment 4.Presentation 5.End Semester Examination	1. Course-end survey

AUDITORY PERCEPTION **L: 12 Hrs**

Listening for understanding & information - short announcements, short conversations, telephonic conversation; Listening to British, American, Australian and Neutral Accent of Indian English; Listening and synthesizing information; Listening to TED/INK Talks (General); Critical review of short films, documentaries.

ORAL FLUENCY **L: 12 Hrs**

Informal introduction of self and others, conversation starters, articulating simple thoughts and ideas with clarity, Seeking Permission, Talking about People and Places. Describe an object or event. Retelling an incident, voicing opinions, persuasion skills, speaking from a single perspective (debate) - preparing and delivering an informal talk, Introduction to Presentation Skills – Formal tone – Impersonal style - Structuring and Presenting information. Transcode graphics orally.

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FOUNDATIONS OF ACADEMIC WRITING **L: 12 Hrs**

Plan and write a library-based coursework assignment on an Engineering topic. Read academic textbooks and journal articles. Research and analyse scientific data and express understanding. Procuring information - Identifying research papers in a specific discipline, reading abstracts of research papers, reading the abstract of projects, reading articles from journals and publications and documenting/ archiving information.

TRAITS OF RESEARCH WRITING **L: 12 Hrs**

Reading research articles and summarizing. Review of Secondary sources - Writing an abstract - Writing an introduction to a paper in academic writing - Avoiding plagiarism – Bibliography – International Academic Styles of writing a research paper - Peer Evaluation.

PROCESS OF PREPARING A RESEARCH ARTICLE **L: 12 Hrs**

Research Projects – Converging areas of interest into field of research - Identifying the problem of research – Formulating hypothesis – Research Objectives – Literature Review – Identifying the research gap - Research methodology – Requirements – Plan of work – Result and Discussion – Conclusion – References – Appendices.

Total : 60 Hrs

Reference Books:

1. English and Communication Skills—S.P.Dhanavel—Orient Blackswan Pvt Lted, Hyderabad.
2. Effective Technical Communication—Ashraf Rizvi—Tata McGraw Hill, New Delhi.
3. A Course in Communication Skils—Kiranmai Dutt, Geetha Rajeevan, C.L.N.Prakash—Foundation Books, New Delhi.

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U17MAT1101 **Linear Algebra and Calculus**
(Common to AE, AUE, CE, MCE, ME)

L	T	P	J	C
3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1 :Identify eigen values and eigen vectors , apply Cayley Hamilton theorem and convert quadratic form to canonical form. K3

CO2 : Determine the radius, centre, circle of curvature of functions K4

CO3 : Discover the evolutes of curves and the envelope of a family of curves. K4

CO4 : Solve first order ordinary differential equation and apply in some physical situations. K4

CO5 : Solve higher order ordinary differential equations and apply the knowledge to physical situations K4

CO6 Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate functions. K4

Pre-requisites :

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M		M	S	S
CO2	S	S							M	M		M	S	S
CO3	S	S							M	M		M	S	S
CO4	S	S							M	M		M	S	S
CO5	S	S							M	M		M	S	S
CO6	S	S							M	M		M	S	S

Course Assessment methods

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

MATRICES 9 + 3 Hours

Rank of a matrix – Linearly dependent and independent vectors – Eigen values and eigen vectors of a real matrix – Properties of eigen values and eigen vectors – Cayley Hamilton theorem (excluding proof) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

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GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS **4 + 1 Hours**

Curvature – Radius, Centre and Circle of curvature in Cartesian, Parametric and Polar form

EVOLUTES AND ENVELOPES **5 + 2 Hours**

Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – properties of evolute and envelope.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **9 + 3 Hours**

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and Newton's law of cooling

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS **9 +3 Hours**

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients - Application - Mass-spring mechanical system. (Differential equations and associated conditions should be given).

FUNCTIONS OF SEVERAL VARIABLES **9 +3 Hours**

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total : 60 Hours

REFERENCES

1. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition.
3. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
5. Arunachalam, T., Engineering Mathematics I, Sri Vignesh Publications, Coimbatore. (Revised) 2009.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003.
7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).

E books and online learning materials

(1) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage Learning India Pvt. Ltd.

(2) Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

Online Courses and Video Lectures:

www.mathworld.wolfram.com

http://nptel.ac.in

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U17PHT1002 Physics for Automobile Engineering

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Various engineering subjects and applications.

CO2: Crystal structure identification of engineering materials

CO3: Application of lasers and optical fibers in engineering and technology

CO4: Perceive the basics of quantum and its applications

CO5: Understand the concepts of production and detection of ultrasonic waves for various applications.

CO6: Acquire the knowledge of various materials testing procedures.

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										M	S	S
CO2	S	M			S							M	S	M
CO3	S	M			S							M	M	M
CO4	S	M			S							M	M	M
CO5	S	M			S							M	S	M
CO6	S	M					M					M	S	M

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Course Assessment methods

Direct
4. Continuous Assessment Test I, II 5. Assignment; Journal paper review, Group Presentation, Project report, End Semester Examination
Indirect
1. Course-end survey

CRYSTAL PHYSICS **9 Hours**

Space lattice – unit cell – lattice planes – Bravais space lattices – Miller indices – calculation of interplanar distances – atomic radius – co- ordination number – packing factor for SC, BCC, FCC and HCP structures- crystal imperfections: point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

APPLIED OPTICS **9 Hours**

Air wedge and its applications - Lasers – spontaneous and stimulated emissions – Einstein's coefficients – Types of LASER – Nd : YAG, CO_2 and semiconductor laser – Homo junction (qualitative description) – applications –Holography (Qualitative only) – optical fiber – principle and propagation of light in optical fibers – numerical aperture and acceptance angle –types of optical fibers – light sources and detectors – communication system.

QUANTUM PHYSICS **9 Hours**

Introduction - Planck's quantum theory of black body radiation (derivation) – photo electric effect(Qualitative only) – Compton effect (derivation) and experimental verification of Compton effect – De-Broglie's concept - Schrodinger wave equation – time independent and time dependent equations (derivations) – physical significance of wave function – particle in a box (one dimensional case) – electron microscope – scanning electron microscope – transmission electron microscope.

ULTRASONICS **6 Hours**

Ultrasonics: Production of ultrasonics: magnetostriction oscillator - piezo electric method – properties –detection – acoustic grating – application of Ultrasonic's in automotive industries

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MATERIALS TESTING **12 Hours**

Destructive: 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 test. Non Destructive: Liquid Penetrant method – ultrasonic flaw detector: A scan, B scan, C scans – X- ray radiography and fluoroscopy – thermography.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Avadhanulu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S.Chand& Company Ltd, New Delhi,2005.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.
3. Richard Wolfson, ―Essential University Physics, Vols. 1 and 2. Pearson Education, Singapore, 2011.
4. Crawford Jr Waves, F.S. – Berkeley Physics Course, Vol. 3, 2008.
5. Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
6. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw-Hill Book Company, 1994.
7. Purcell, E.M, ―Electricity and Magnetism – Berkeley Physics Course, Vol. 2, Tata McCraw-Hill ,2007. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
8. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.

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U17 CHT1001 Chemistry for Automobile Engineering

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Discuss Basic concepts of electrochemistry involved in battery assembly (K2)

CO2: Apply the principle of electrochemistry and assemble a battery (K4)

CO3: Defend the Corrosion problems (K2)

CO4: Summarize different types of fuels and lubricants (K2)

CO5: Discuss basic concepts of combustion (K3)

CO6: Outline the principles and instrumentation of spectroscopic techniques involved in material characterization (K2)

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M								S
CO2	S													S
CO3	M	M				M							S	M
CO4	M		M			M								S
CO5	S												M	
CO6	M												M	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

ELECTROCHEMISTRY 9 Hours

Constitution of alloys - Solid solutions, substitutional and interstitial.

Phase diagram : Isomorphous, eutectic, peritectic, eutectoid and peritectroid reactions - Phase rule - condensed phase rule - construction of phase diagram (thermal analysis) - Applications of phase rule: Simple eutectic system (Ag - Pb, Fe - C system)

CORROSION SCIENCE 6 Hours

Corrosion: Principles and Mechanism of electrochemical corrosion - Factors influencing corrosion.

Types of corrosion: Galvanic corrosion - Differential aeration corrosion (pitting corrosion, water line corrosion) - Stress corrosion.

Corrosion control: Inhibitors - Dehumidifier gels - Cathodic protection (sacrificial anode) - Plating Techniques: Plating - Need for plating - Electroforming -Electropolishing - Electrochemical machining - Electrophoretic painting.

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ENERGY STORING DEVICES 12Hours

Batteries: Factors for selection of batteries - Rating calculation using datasheet.

Primary Battery (Alkaline battery) - Secondary Battery (Lead acid storage battery, Nickel - Cadmium battery, Lithium ion battery and Lithium polymer battery) - Nuclear battery - Nano Battery

Flow battery: Introduction - Construction of Types of fuel cell

Solar Cells: Silicon Solar cells - Hybrid Solar cells - Dye sensitized solar cells - Tandem Solar cells.

FUELS: COMBUSTION AND LUBRICANTS 9 Hours

Fuels: Classification of fuels - Liquid Fuel: Manufacturing of synthetic petrol (Fischer Tropsch method)

Gaseous fuels: Production, composition and uses of producer gas, water gas and natural gas.

Combustion: Gross and net calorific value - Explosive range - Calculation of minimum amount of air for combustion - Spontaneous ignition temperature - Flue gas analysis (Orsat apparatus).

Lubricants: Classification - Functions - Properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud and pour point) - Semi solid lubricant (greases with calcium based, sodium based, lithium based) - solid lubricants (graphite, molybdenum disulphide).

SPECTROCHEMICAL TECHNIQUES IN MATERIAL CHARACTERISATION 9 Hours

Introduction to spectroscopy - Beer Lambert's Law.

Principle, instrumentation (block diagram only) and applications of : Colorimetric analysis (Estimation of concentration of Ferrous and copper ions in solutions), IR spectroscopy, Flame photometry, XRD, SEM.

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Atkins, P. and de Paula, J. Atkins, Physical Chemistry, 9th ed., Oxford Univ. Press, 2009.
2. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
3. Derek Pletcher and Frank C Walsh., Industrial Electrochemistry, Blackie Academic and Professional, London, 1993
4. Ahmed Z., Principles of corrosion engineering and corrosion control, Butterworth Heinemann, 2006.
5. David Linden & Thomas B. Reddy., Handbook of Batteries, 3rd edition, McGraw-Hill Companies, Inc. 2001
6. Revankar S.T., Majumdar P., Fuel Cell: Principles, Design and Analysis, CRC Press, 2014.
7. Samir Sarkar., Fuels and Combustion, 3rd Edition , Orient Longman, India, 2009.
8. Jain P.C. and Jain. M., Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
9. Dara S.S. and Umare S.S., A text book of Engineering Chemistry, S.Chand and Company Limited, New Delhi, 2014.
10. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers, Coimbatore, 2013
11. Sharma Y.R., Elementary Organic Spectroscopy, 5th Revised Edition, S.Chand and Company Limited, New Delhi, 2013.

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U17MET1101 ENGINEERING GRAPHICS

L	T	P	J	C
2	2	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Construct various plane curves.
C02: Construct projection of points and projection of lines.
CO3: Develop projection of surfaces and solids.
CO4: Solve problems in sections of solids and development of surfaces.
CO5: Apply the concepts of isometric, and perspective projections
CO6: Apply free hand sketching in engineering practice.

Pre-requisites :

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M											S	
CO2	S	S									W		S	
CO3	S	S									M		S	
CO4	S	S											S	
CO5	S												S	
CO6	S												S	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 4. Model examination (lab component) 5. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS AND LINES 9 Hours

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

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PROJECTIONS OF SURFACES AND SOLIDS **9 Hours**

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane. Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **9 Hours**

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

PICTORIAL PROJECTIONS **9 Hours**

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms and pyramids when its base resting on the ground by vanishing point method.

FREE-HAND SKETCHING **9 Hours**

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

Sketching pictorial views from given orthographic views.

Theory: 20	**Tutorial: 25**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Bhatt ND, Engineering Drawing, Charotar Publishing house, 54th edition, 2014.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2016.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2006.
4. Basant Agrawal and Agrawal C.M, Engineering Drawing and Graphics,McGraw Hill Edition(India), 2013.
5. Gopalkrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2014.

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U17CSI1211 **Structured Programming using C**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the basics of problem solving techniques

CO2: Select appropriate data types and control structures for solving a given problem

CO3: Illustrate the representation of arrays, strings and usage of string operations

CO4: Illustrate the importance of pointers and functions

CO5: Explain the fundamentals of structures and unions

CO6: Explain the fundamentals of file handling

Pre-requisite: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	2												S
CO2	S	2												S
CO3	S	S			S				S	S				S
CO4	M	S			S				S	S		M		S
CO5	M	S			S				S	S		M		S
CO6	S	S												S

Course Assessment methods:

Direct
1. Continuous Assessment Test I, II (Theory Component) 2. Assignment (Theory Component) 3. Group Presentation (Theory Component) 4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 5. Model examination (lab component) 6. End Semester Examination (Theory and lab component)
Indirect
1. Course-end survey

Theory Component contents

FUNDAMENTALS OF PROBLEM SOLVING **9 Hours**

Programs and Programming – Classification of Programming Languages based on Generations – Structured Programming Concept – Algorithm – Flowchart – Pseudo code

STRUCTURED PROGRAMMING **9 Hours**

Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements

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ARRAYS AND STRINGS **9 Hours**

Defining an array – Processing an array – Passing arrays to functions –Multidimensional Arrays

Defining a string – NULL character – Initialization of Strings – Reading and Writing Strings – Processing Strings – Character Arithmetic – Searching and Sorting of Strings – Library functions for strings

FUNCTIONS, STORAGE CLASSES AND POINTERS **9 Hours**

Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Recursion – Storage classes – Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers – Dynamic memory allocation

STRUCTURES, UNIONS AND FILES **9 Hours**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek

Theory: 45 hours	**Tutorial:0 hours**	**Practical:0 hours**	**Total Hours: 45 hours**

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

Lab Component

List of Experiments **30 Hours**

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.
11. Programs on file operations and modes.
12. Working with text files, random files and binary files

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Hours**

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REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.

2. PradipDey and ManasGhosh, “Programming in C”, Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.

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U17PHP1501	Physics laboratory (Common to AE, AU, BT, CE, CS, IT, MC,TX)	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Determine different physical properties of a material like thermal conductivity, thickness of the material.

CO2: Perform experiments involving the physical phenomena like interference and diffraction

CO3: Apply physical theories in real life situations by also taking into account its limitation.

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	M
CO2		M	S										S	M
CO3		S		M									S	M

Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

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List of Experiments **30 Hours**

1. Determine thermal conductivity of the given cardboard by Lee's disc method.
2. Determine the thickness of a thin sheet by air wedge method.
3. Determine the co-efficient of viscosity of the given liquid by Poiseuille's flow method.
4. Determine the value of acceleration due to gravity by compound pendulum.
5. Calculate the solar panel efficiency by using lux meter.
6. Determine the wavelengths of the violet, blue, green and yellow in mercury spectrum using spectrometer grating method (the green spectral line for which the wavelength is 5461 A^0).
7. Determine Young's modulus of the given bar using non-uniform bending method.
8. Calculate the frequency of the given tuning fork by longitudinal and transverse mode of vibrational methods.
9. Determine the velocity of ultrasonic sound and compressibility of the given liquid by using ultrasonic interferometer.
10. By using semiconductor laser determine: i) Wavelength of LASER using grating. ii) Acceptance angle & numerical aperture of optical fiber (grating element: N=5,00,000 lines/meter).

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Hours**

REFERENCES

1. Laboratory Manual of Engineering Physics by Dr. Y. Aparna & Dr. K. Venkateswara Rao (V.G.S Publishers)
2. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985. 11. 12.
3. "Great Experiments in Physics", M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966. Gupta S.C, and Kapur, J.N.

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U17MEP1501	ENGINEERING PRACTICES LABORATORY	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select the various tools and equipment's used in the fabrication workshop.

CO2: Develop various models in carpentry and fitting

CO3: Make components using sheet metal work.

CO4: Select the various tools and joints for different applications in plumbing.

CO5: Demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) and test the components.

CO6: Estimate DC and AC Voltage and currents using appropriate measuring instruments.

Pre-requisites :

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2													S	
CO3			M										S	
CO4						W							S	
CO5	M												S	
CO6	M												S	

Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 Hours**

GROUP – I

A. CIVIL ENGINEERING

1. Carpentry
   - Study of carpentry tools
   - Preparation of T joint
   - Preparation of dovetail joint

2. Plumbing
   - Study of pipeline joints

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B. MECHANICAL ENGINEERING

1. Fitting
   - Study of fitting tools
   - Preparation of L joint
   - Preparation of square joint

2. Sheet Metal Working
   - Study of sheet metal working tools
   - Preparation of cone
   - Preparation of tray

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

C. ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities–voltage, current, power & Power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

D. ELECTRONIC ENGINEERING PRACTICE

1. Testing of Electronic components and Measurements using a digital multimeter.
2. Study of CRO and Function generator.
3. PCB Design and Fabrication.
4. Soldering simple electronic circuits and checking continuity

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Hours**

Signature of BOS chairman, Auto

U17VEP1501 **PERSONAL VALUES**

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Become an individual in knowing the self
CO 2 : Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.
CO 3: Practice simple physical exercise and breathing techniques
CO 4: Practice Yoga asana which will enhance the quality of life.
CO 5: Practice Meditation and get benefited.
CO 6: Procure Self Healing techniques for propagating healthy society

Pre-requisites : NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1												M		
CO2										S				
CO3						M								
CO4						S			M					
CO5										M				
CO6								W				S		

Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment 2. Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities: **30 hours**

1.Knowing the self : Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.

2. Mental Health : Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.

3.Physical Health: Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.

4.Core value : Self love& Self care Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.

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5.Fitness: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi suddhi pranayama – Silent sitting and listening to nature – Meditation.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 hours

REFERENCES

1. KNOW YOURSELF — SOCRATES – PDF format at www.au.af.mil/au/awc/awcgate/army/rotc_self-aware.pdf

2. STEPS TO KNOWLEDGE: The Book of Inner Knowing – PDF format at www.newmessage.org/wp-content/uploads/pdfs/books/STK_NKL_v1.5.pdf

3. PROMOTING MENTAL HEALTH - World Health Organization – PDF format at www.who.int/mental_health/evidence/MH_Promotion_Book.pdf

4. LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf

5. PERSONALITY DEVELOPMENT By SWAMI VIVEKANANDA www.estudantedavedanta.net/Personality-Development.pdf

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Semester 2

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U17MAT2101	Advanced Calculus and Laplace Transforms (Common to AE, AUE, CE, MCE, ME)	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1 : Evaluate multiple integrals and apply them to find area, moment of inertia, centre of mass and volume K3

CO2 : Apply various vector differential operators and integral theorems for solving Engineering problems involving cubes and rectangular parallelepipeds. K4

CO3 : Construct analytic functions of complex variables and transform functions from z-Plane and w-plane and vice-versa, using conformal mappings K4

CO4 : Use the fundamentals of residues, complex integration to evaluate real integrals K3

CO5 : Transform functions in time domain to frequency domain using Laplace transform K4

CO6 : Convert ordinary differential equations into algebraic equations using Laplace Transform and solve them using inverse Laplace transform K4

Pre-requisites :

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S							M	M		M	S	
CO2	S	S							M	M		M	S	
CO3	S	S							M	M		M	S	
CO4	S	S							M	M		M	S	
CO5	S	S							M	M		M	S	
CO6	S	S							M	M		M	S	

Course Assessment methods

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

MULTIPLE INTEGRALS **9 + 2 Hours**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between cartesian and polar coordinates - Triple integration in cartesian coordinates – Application : Area as double integral –- Moment of inertia - Centre of mass - Volume as triple integral.

VECTOR CALCULUS **9 + 3 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

9 + 3 Hours

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ANALYTIC FUNCTION

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs) – Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ and bilinear transformation.

COMPLEX INTEGRATION **9 + 2 Hours**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals - Unit circle and semi-circular contours (excluding poles on real axis).

LAPLACE TRANSFORM **5 +3 Hours**

Definition - Properties – Superposition - Shift in t - Shift in s - Time Derivatives - Time Integral – Initial and Final Value Theorems – Periodic functions: sine wave, saw-tooth, square and triangular waves

INVERSE LAPLACE TRANSFORM **4 +2 Hours**

Inverse Laplace Transform – Simple system dynamic models – Transfer Functions – Poles and Zeroes - Response of First-Order Systems - Solution of RC Free, Step and Sinusoidal Responses; Response of Second-Order Systems - Free Response, step Response - Convolution theorem.

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total : 60 Hours

REFERENCES

1. Kreyzig E., Advanced Engineering Mathematics, John Wiley & Sons (Asia), Pvt, Ltd., Singapore, 10th Edition, 2010
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 42nd Edition, 2012.
3. Philip D. Cha, James J. Rosenberg, Clive L. Dym, Fundamentals of Modelling and Analyzing Engineering Systems, Cambridge University Press, United Kingdom, 2000.
4. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill, Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
5. Venkataraman M.K., Engineering Mathematics, Volume - II, The National Pub. Co., Chennai, 2003.
6. Kandasamy P., Thilagavathy K. and Gunavathy K., Engineering Mathematics, S. Chand & Co., New Delhi, 2008.
7. Arunachalam T. and Sumathi K., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore, Third Edition, 2011.
8. Weir .MD, Hass J, Giordano FR: Thomas Calculus Pearson education 12th ED, 2015.
9. N.P.Bali., Dr. Manish Goyal., ―Transforms and partial Differential equations, University science Press, New Delhi, 2010.

E books and online learning materials

(1) Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint 2009, Cengage Learning India Pvt. Ltd.

(2) Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

Online Courses and Video Lectures:

http://nptel.ac.in/course.php?disciplineId=111

www.mathworld.wolfram.com

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U17PHT2002 **Material Science for Automobile Engineering**

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Recognize the core concepts of conducting materials.

CO2: Perceive the preambles, types of semiconductors and to conceive the Hall effect along with its applications

CO3: Categorize the magnetic materials based on their properties**.**

CO4: Elucidate the basics of superconductors and its applications

CO5: Understand the mechanism of dielectrics and its engineering applications.

CO6: Confer the properties, preparation and applications of new engineering materials and nano materials.

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M										M	S	S
CO2	S	M										M	S	S
CO3	S	M										M	S	S
CO4	S	M										M	S	S
CO5	S	M			M							M	S	S
CO6	S	M										M	S	S

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation 3. End Semester Examination
Indirect
1. Course-end survey

CONDUCTING MATERIALS **9 Hours**

Classical free electron theory of metals-electrical conductivity – thermal conductivity - expression – Wiedemann Franz law(derivation) – Lorentz number – drawbacks of classical theory – Fermi distribution function – density of energy states – effect of temperature on Fermi energy.

SEMICONDUCTING MATERIALS **9 Hours**

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Origin of band gap in solids (qualitative treatment only) - carrier concentration in an intrinsic semi conductor (derivation) – Fermi level – variation of Fermi level with temperature - electrical conductivity – band gap semiconductor –extrinsic semiconductor(Qualitative only) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – experimental set up – applications.

MAGNETIC AND SUPERCONDUCTING MATERIALS **9 Hours**

Magnetic materials: Properties of dia, para, ferro, anti-ferro and ferri magnetic materials – domain theory of ferromagnetism - hysteresis – soft and hard magnetic materials – ferrites – applications.

Superconducting materials: Superconducting phenomena – properties of superconductors – Meissner effect, isotopic effect. Type I &Type II superconductors – high Tc superconductors- applications: cryotron, magnetic levitation and squids.

DIELECTRIC MATERIALS **9 Hours**

Electronic, ionic, orientation and space charge polarization - frequency and temperature dependence of polarization – dielectric loss –Internal field – Classius - Mossotti relation– dielectric breakdown – different types of break down mechanism - ferro electric materials - properties and applications.

NEW ENGINEERING MATERIALS AND NANO TECHNOLOGY **9 Hours**

New engineering materials: metallic glasses – preparation, properties and applications – shape memory alloys (SMA) – characteristics- properties of NiTi alloy applications, advantages and disadvantages of SMA.

Nano materials: synthesis – chemical Vapour deposition – sol – gel, electro deposition— ball milling –properties of nano particles and applications – carbon nano tubes – fabrication method – pulsed laser deposition – structure, properties and applications.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Pillai S.O., Solid State Physics, 5th edition, New Age International Publication, New Delhi, 2003.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2003.
3. William D CallisterJr, ―Materials Science and Engineering-An Introduction‖, John Wiley and Sons Inc., Sixth Edition, New York, 2010.

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4. Van Vlack, ―Elements of Material Science and Engineering‖, Pearson Education India, 2008.
5. Raghavan V. Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 1999
6. Rajendran V. and Marikani A., Materials science, 5th edition, Tata Mc-Graw-Hill publishing company Ltd., 2004
7. James F Shackelford S, ―Introduction to Materials Science for Engineers‖, Third Edition, Macmillan Publishing Company, New York. 1992
8. Gopal S., Materials Science, Inder Publications, Coimbatore, 2007.

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U17 CHT2001 Metallurgical Chemistry for Automobile

L	T	P	J	C
3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Construct a phase diagram (K3)
CO2: Discuss the constitution of alloys and categorize the alloys (K2)
CO3: Discuss the applications of ferrous alloys based on their properties (K3)
CO4: Discuss the applications of Non-ferrous materials based on their properties (K3)
CO5: Outline about the non-metallic materials (K2)
CO6: Discuss the heat treatment techniques and apply in real life situation (K3)

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M					M							S	
CO2	S												S	
CO3	M	M				M							S	
CO4	M		M			M							S	
CO5	S												S	
CO6	M												S	

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstrationetc (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9 Hours

Constitution of alloys - Solid solutions, substitutional and interstitial - Phase rule - condensed phase rule - Construction of phase diagram (thermal analysis) - Applications of phase rule: Simple eutectic system (Ag - Pb, Fe - C system) - Isomorphism, eutectic, peritectic, eutectoid and peritectoid reactions.

FERROUS AND NON-FERROUS MATERIALS AND ALLOYS 12 Hours

Composition, structure and properties of

Carbon steels : low alloy steels - stainless steels - tool steels

Cast irons : Grey iron, ductile iron, white iron and malleable iron

Non-ferrous alloys : Copper alloys -Aluminum alloys - Magnesium alloys - Nickel alloys and Titanium alloys.

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NON-METALLIC MATERIALS **9Hours**

Polymeric materials - Formation of polymer structure - Properties, processing and applications of engineering polymers: Advanced structure ceramics- WC-TiC- Al_2O_3 - SiC - Si_2N_4, CBN, Diamond and composites.

ELECTRICAL & THERMAL PROPERTIES OF MATERIALS **6 Hours**

Electrical conduction - Semi conductivity - Super conductivity - Electrical conduction in ionic ceramics and in polymers - Dielectric behavior- Ferroelectricity- Piezoelectricity - Heat capacity - Thermal expansion - Thermal conductivity -Thermal stresses.

HEAT TREATMENT **9 Hours**

Definition - Annealing, types - normalizing, hardening and Tempering of steel - Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram CCR - Harden ability, Jominy end quench test - Austempering – Martempering - Case hardening - types.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Hours**

REFERENCES

1. Williams D Callister, Material Science and Engineering, Revised Indian edition, Wiley India Pvt Ltd, 2007
2. Upadhyay. G.S. and AnishUpadhyay, Materials Science and Engineering, Viva Books Pvt.Ltd., New Delhi, 2006.
3. Raghavan.V, Materials Science and Engineering, Prentice Hall of India Pvt. Ltd., 1999.
4. Kenneth G.Budinski and Michael K. Budinski, Engineering Materials, 4 th Indian Reprint, Prentice Hall of India Private Limited, 2002.
5. Avner, S.H., Introduction to Physical Metallurgy, McGraw Hill Book Company, 2017.
6. U.C. Jindal : Material Science and Metallurgy, Engineering Materials and Metallurgy, First Edition, Dorling Kindersley, 2012

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U17MET2102 ENGINEERING MECHANICS

L	T	P	J	C
3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the concept of equilibrium of particles subjected to concurrent forces.

CO2: Determine the reactions in different types of support and loading conditions.

CO3: Estimate the moment of inertia for various shapes and sections.

CO4: Make use of various concepts of friction.

CO5: Solve problems using the concepts in kinematics

CO6: Solve problems in kinetics.

Pre-requisites :

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2		S											S	
CO3		S											S	
CO4		M											S	
CO5	S												S	
CO6	S												S	

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstration etc (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

BASICS & STATICS OF PARTICLES **12 Hours**

Introduction - Units and Dimensions - Laws of Mechanics Lame's theorem, Parallelogram and triangular Laws of forces – Coplanar Forces - Resolution and Composition of forces – Free body diagram - Equilibrium of a particle.

EQUILIBRIUM OF RIGID BODIES **12 Hours**

Moment of a force about point – Varignon s theorem- Moment of a couple-Resolution of force in to force couple system-Resultant of coplanar non concurrent system - Types of supports and their reactions- Requirements of stable equilibrium - Equilibrium of Rigid bodies in two dimensions.

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PROPERTIES OF SURFACES AND SOLIDS **12 Hours**

First moment of area and the Centroid of sections Rectangle, circle, triangle, T section, I section Angle section and Hollow section. Second and product moments of plane area Rectangle, triangle, circle. T Section, I section, Angle section and Hollow section, Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia.

FRICTION **12 Hours**

Frictional force-Law of coulomb friction, simple contact friction, Rolling resistance and Belt friction, Ladder friction, Wedge friction.

DYNAMICS OF PARTICLES **12 Hours**

Kinematics: Rectilinear & Curvilinear motion of particles, Displacements Velocity and acceleration.
Kinetics: Newton's law, Work Energy method, Impulse and Momentum, Impact of elastic bodies.

Theory: 45	Tutorial: 15	Practical:	Project: 0	Total: 60 Hours

REFERENCES

1. Beer F.P. and Johnson Jr. E.R., Vector Mechanics for Engineers, Vol. I Statics and Vol. II Dynamics, McGraw-Hill International Edition, 2004
2. Hibbeller, R.C., Engineering Mechanics, Vol. I Statics and Vol. II Dynamics, Pearson Education, Asia Pvt. Ltd., 2000.
3. Ashok Gupta, Interactive Engineering Mechanics Statics A Virtual Tutor, Pearson Education, Asia Pvt. Ltd., New Delhi, 2002.
4. Palanichamy M.S., and Nagan S., Engineering Mechanics (Statics & Dynamics) Tata McGraw Hill, 2001.
5. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition, Pearson Education, Asia Pvt. Ltd., 2003.
6. Sukumar T.R. and Sridhar S., Engineering Mechanics, Inder Publications, Coimbatore.

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U17EET2013	INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Acquire the fundamental knowledge of Electric circuits and semiconductor devices
CO2: Select a suitable semiconductor device for specific application
CO3: Understand the functionality of Op-amps and gates
CO4: Understand the construction, working principle, characteristics and applications of motors
CO5: Apply the fundamental laws of magnetic circuits to electrical motors
CO6: Choose a suitable motor for desired application

Pre-requisites : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S				W									S
CO2	S	M												S
CO3														S
CO4	M													S
CO5		M		M										S
CO6	M				W									S

Course Assessment methods

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

ELECTRIC CIRCUITS FUNDEMENTALS — 8 Hours

(Qualitative Treatment Only)

Ohm's law, Kirchoff's law, Passive elements.

Introduction to DC voltage: Relation between Voltage, Current, Resistance and Power in Resistance, Inductance and Capacitance. Energy stored in the passive elements.

Introduction to AC voltage: Alternating quantity, cycle, time period, frequency and average and RMS value, Relation between Voltage, Current, Resistance and Power in ac circuits. Energy stored in the passive elements.

Electromagnetism: Magnetic flux, Flux density, Permeability, Field intensity, –Faraday's laws of Electromagnetic Induction – Self-inductance and Mutual inductance, Fleming's rule.

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LOW POWER SEMICONDUCTOR DEVICES **7 Hours**
(Qualitative Treatment Only)
Symbol, operation and V-I Characteristic and types of Semiconductor diode - Zener diode- photo diode - light emitting diode, Bipolar Junction transistors, JFET, MOSFET

HIGH POWER SEMICONDUCTOR DEVICES: **7 Hours**
(Qualitative Treatment Only)
Symbol, operation and V-I Characteristic of Power diodes, Power Bipolar Junction transistors –Power MOSFET, IGBT, SCR. Comparison of power semiconductor devices.

INTEGRATED CIRCUITS (Qualitative Treatment Only) **8 Hours**
Analog Electronics: Operational amplifiers, Ideal op-amp, adder, subtractor, amplifiers – inverting, non-inverting and differential amplifiers, Integrator, Differentiator.
Binary logic gates: – AND, OR, NOT, Universal gates, Introduction to Boolean algebra, Multiplexers, De-multiplexers, Encoders, Decoders.

ELECTRICAL MOTORS (Qualitative Treatment Only) **8 Hours**
DC motor: Types of motors, Principle of operation – Back-emf and voltage equation – Torque and speed Characteristics of Series, Shunt and compound motors
Transformer: Ideal Transformer, transformation ratio, Emf equation, Applications
Ac motors: Single phase induction motor, Three phase induction motor – Cage rotor and Wound rotor – Principle of operation – Torque Slip characteristics

SPECIAL MACHINES: (Qualitative Treatment Only) **7 Hours**
Introduction, Stepper motor, Types of stepper motor, Permanent Magnet DC motor, to Brushless DC motor, Switched Reluctance Motor, Servo motor, Selection of motor for automotive applications

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Muthusubramanian R., Salivahanan S. and Muraleedharan. K.A., Basic Electrical Electronics and Computer Engineering, Tata Mcgraw Hill, II edition, 2006.
2. Thyagarajan T., Sendur Chelvi K.P. and Rangaswamy T.R., Engineering Basics: Electrical, Electronics and Computer Engineering, Revised II edition, New Age International Pvt. Ltd., 2007
3. Thomas L Floyd, Electronic Devices, 6th edition, Pearson Education, 2003.
4. Roy Choudhury D., Shail B Jain, Linear Integrated Circuits, II Edition, New Age International, 2003
5. Theraja B.L., Fundamentals of Electrical Engineering and Electronics, S. Chand Publishing, 2012.
6. Sen P. C., Principles of Electric Machines and Power Electronics, III Edition, Wiley Global Education, 2013

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U17CHP2501	Chemistry Laboratory (COMMON TO AE, AU, BIO, CE & MCE)	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Prepare standard solutions (S1)

CO2: Analyse the properties of water by applying the chemical concepts (S2)

CO3: Analyse the solutions by electrochemical techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

CO4: Analyse the solutions by spectroscopic techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												M	
CO2	M												M	
CO3	M					M							M	
CO4	M					M							M	

Course Assessment methods

Direct
1. Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments **30 hours**

1. Preparation of normal solutions of the following substances - Sodium carbonate, Hydrochloric acid and Buffer solution

WATER TESTING

2. Determination of total, temporary and permanent hardness by EDTA method.
3. Estimation of DO by Winkler's method
4. Estimation of alkalinity by Indicator method.
5. Estimation of chloride by Argentometric method.

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ELECTRO CHEMICAL ANALYSIS

6. Estimation of hydrochloric acid by pH metry.
7. Conductometric estimation of mixture of acids and strong base
8. Estimation of corrosion of Iron by Potentiometry

PHOTOMETRY

9. Estimation of the extent of dissolution of Copper / Ferrous ions by Spectrophotmetry.
10. Estimation of sodium and potassium in water by Flame photometry.

DEMONSTRATION

11. Determination of Fire point and Flash point
12. Determination of Cloud and Pour point
13. Microscopic usage in Metallurgy.
14. Determination of Molecular weight by Viscometer

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2012.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London, 2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2011.

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U17EEP2511

ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Understand the performance characteristics of DC Motors
CO2: Understand the performance characteristics of AC Motors
CO3: Understand the characteristics of semiconductor devices.
CO4: Understand the VI characteristics of BJT.
CO5: Understand Ohms and Kirchhoff's Law.

Pre-requisites :

NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S				W									S
CO2	S	M												S
CO3														S
CO4	M													S
CO5		M		M										S
CO6	M				W									S

Course Assessment methods

Direct
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination
Indirect
1. Course-end survey

List of Experiments 30 Hours

ELECTRONICS:

1. Verification of Ohms and Kirchhoff's Law
2. Power Measurement in Simple RLC Circuits
3. V/I Characteristic of PN Junction Diode
4. V/I Characteristic of Zener Diode
5. V/I Characteristic of BJT

ELECTRICAL:

1. Torque - speed characteristics of dc shunt motor
2. Torque - speed characteristics of dc Compound motor
3. Torque - slip characteristics of single phase Induction Motor
4. Torque - slip characteristics of three phase Induction Motor
5. Open circuit test on transformer for finding the transformation ratio

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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REFERENCES

1. Veerarajan T., "Probability and Statistics", Tata McGraw-Hill, New Delhi, 2007 & 2nd Reprint 2004.
2. Gupta S. P, "Statistical Methods", Sultan Chand & Sons Publishers, 2004.
3. Johnson R. A., "Miller & Freund's Probability and Statistics for Engineers", Sixth Edition, Pearson Education, Delhi, 2000.
4. Gupta S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, Ninth Edition, New Delhi, 1996
5. Walpole R. E., Myers S.L. & Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 2002

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U17VEP2502 INTERPERSONAL VALUES

L	T	P	J	C
0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop a healthy relationship & harmony with others
CO 2: Practice respecting every human being
CO 3: Practice to eradicate negative temperaments
CO 4: Acquire Respect, Honesty, Empathy, Forgiveness and Equality
CO 5: Practice Exercises and Meditation to lead a healthy life
CO 6: Manage the cognitive abilities of an Individual

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										S				
CO2									S					
CO3											M	S		
CO4						M								
CO5												M		
CO6											M			

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities: **30 hours**

1. Introduction: Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.

2. Maneuvering the temperaments: From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.

3. Core value : **Truthfulness -** Honesty –Helping–Friendship – Brotherhood – Tolerance – Caring & Sharing – Forgiveness – Charity –Sympathy — Generosity – Brotherhood - Adaptability.

4.Pathway to Blissful life :

Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.

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5.Therapeutic measures: Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.

Theory: 0	Tutorial: 0	Practical: 30	Project: 0	Total: 30 hours

REFERENCES

1. INTERPERSONAL SKILLS Tutorial (PDF Version) - TutorialsPoint www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska www. publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1
3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishi www.ijhssi.org/papers/v5(5)/F0505034036.pdf
5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publications - www.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pd...

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U17ISR2001–SOCIAL IMMERSION PROJECT

(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	0	4	2

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Achieve the desirable awareness regarding significant social problems and identify the needs to provide a possible and innovative solution.

CO2: Acquire and demonstrate effective professional and technical skills to deal with social issues through innovative leadership and sustainable services / approaches.

CO3: Provide students with a rich practical and socially oriented team work approach.

CO4: Explain how to make leadership decisions concerning organizational structure and the role of project resources on a project's team.

CO5: Enhance technical knowledge in addressing the needs of a community problem.

CO6: Identify tools and techniques for planning and working on a project.

Course Assessment methods

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1			S			S	S					
CO2			M	S		S	M	M	M			
CO3			S	W		S	S		S			M
CO4			S			S	S		W		M	
CO5	S		M			S	M					
CO6			S			S	S					

Direct	Indirect
1. Project Review 2. General report preparation 3. Team Presentation	1. Impact study 2. Field Visit & Observation Skill 3. Course end survey

SOCIAL BONDING AND ENGINEERING

Society and its impact on the individual – Responsibility of individuals towards community building – Essential requirement of the society – Role of an engineering graduate in approaching the requirements - Developing social consciousness.

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ENGINEERING PREREQUISITE FOR ENHANCED SOCIAL LIVING

Theoretical reading (Based on the project / general – Books to be identified by the team) - Inculcating Social immersion and Leadership- Study on the society and identifying problems - Social immersion and Engineering implementation - Analysis of problems on issue based - Identification of causes and effects of the social issue identified.

ESSENTIAL ENGINEERING INNOVATION

Essential Engineering Concepts - Multiple approaches towards the problem &Selection for addressing- Addressing a theoretical social problem -Providing multiple solutions for the problem

PROJECT PLANNING AND APPROACHES

Knowledge on budgeting and fund raising - Approaching agencies related to problems. Partnering with agencies- Presentation Skills - Report preparation

BROAD AREA OF PROJECTS

(Students can also identify their own social issue)

Water / Sanitation and Hygiene - Waste Management -Women Empowerment- Community health - Child health/ Poverty/Education/others - Energy management -Environment Management - Adult Education - -Youth Empowerment - Green Industry - Given above are the broad areas of projects recommended. Projects may vary to individuals/ groups/ class/ branch.

TOTAL : 60 Hours

References:

1. Nicholls Alex and Murdock Alex, Social Innovation Blurring Boundaries to reconfigure markets, Palgrave Macmillan., New York, 2012. :
2. Osburg Thomas and Schmidpeter Rene`, Social Innovation Solutions for sustainable Future. Springer, Germany 2013.
3. Adedeji B. Badiru, STEP Project Management: Guide for Science, Technology, and Engineering Projects. Taylor and Francis Group., Florida 2009.

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ENGLISH ELECTIVES

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U17ENP2501 – ENGLISH FOR PLACEMENT PURPOSES
(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

1. To enhance the logical, analytical and critical thinking skills of the students leading to effective corporate communication.
2. To develop relevant employability skills to cater to the communicative demands of the industry.
3. To adopt relevant job related oral and written communication skills to competently perform in campus recruitments.
4. To present the individuals opinions, persuasion skills and academic curricular along with career profiles.
5. To recognize and establish dynamic corporate communication and relationship.

COURSE OUTCOMES

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

1. Think critically and provide logical solutions to aptitude questions.
2. Interpret visual information into a meaningful coherent paragraph.
3. Comprehend, analyze and respond to simple industrial situations.
4. Express and defend their individual opinions and persuade others in a professional setup.
5. Present a topic and involve in a group discussion effectively.

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								S	S	S	M	S		
CO2								S	S	S	M	S		
CO3								S	S	S	M	S		
CO4								S	S	S	M	S		
CO5								S	S	S	M	S		

S.No	Topic	Hours
	UNIT -1 – Verbal Ability – 12Hrs	
1.1	Introduction to Corporate culture	**1**
1.2	Verbal and Analytical Reasoning	**2**
1.3	Transcoding Graphics	**2**
1.4	Picture Perception & Video Sensitization	**3**
1.5	Placement Test papers	**4**
	UNIT -2 – Presentation Skills – 12Hrs	
2.1	Thematic Oral Presentation	**2**
2.2	Extempore	**4**
2.3	Effective PowerPoint Presentation	**2**

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2.4	Email Writing	**2**
2.5	Resume Writing	**2**
UNIT -3 – Oral Discussion – 12Hrs		
3.1	Introduction to Structure of GD	**1**
3.2	Types of GD	**1**
3.3	GD Practice	**5**
3.4	Introduction to Debate	**1**
3.5	Debate Practice	**4**
UNIT -4 – Interactive Skills – 12Hrs		
4.1	Introduction to Employability Skills	**1**
4.2	Corporate Interaction	**3**
4.3	Interview Process & Kinds of Interviews	**2**
4.4	Mock Interviews	**4**
4.5	Stress Interview	**2**
UNIT -5 – Corporate Skills – 12Hrs		
5.1	Receptive skills	**2**
5.2	Social English	**2**
5.3	Negotiation Skills	**3**
5.4	Rapid interpretation	**2**
5.5	Business Writing	**3**
Total		**60**

Reference:

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. Aptitude Guru : Tricks & Tips - Android Apps on Google Play
3. Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary (By Norman Lewis)
4. Effective Technical Communication Tata Mc Graw Hills Publications (Ashraf Rizvi)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)

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U17ENP2102 - ENGLISH FOR RESEARCH PURPOSES

L	T	P	J	C
0	0	4	0	2

COURSE OBJECTIVES

The students will be facilitated to:

1. Recognize and understand fundamental concepts of research and its methodology.
2. Use the resources to read, interpret and critically evaluate the information.
3. Employ and organize the components of writing skills for research.
4. Craft a research paper in a particular discipline.
5. Present and defend the hypothesis of their research proposal.

COURSE OUTCOMES:

After the course the student will be able to:

- Apply some basic concepts of research and its methodologies.
- Identify appropriate research topics and define research problem.
- Demonstrate knowledge of data analysis and interpretation in relation to the research process.
- Draft a review article/ paper effectively using the components of research writing.
- Participate and present professionally in a research forum.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1							S					S		
CO2				W						S		S		
CO3				S						S		S		
CO4									S	S		S		
CO5									S	S		S		

UNIT-1	INTRODUCTION TO RESEARCH	8 Periods
1.1	Research – Objectives, benefits and types	1
1.2	Choice of topic	1
1.3	Looking for resources	2
1.4	Reading literature review	2
1.5	Citing sources and formation of preliminary bibliography	2
UNIT-2	**FORMATION OF RESEARCH**	**10 Periods**
2.1	Preparing a working outline of research	3
2.2	Formation of hypothesis	2
2.3	Plagiarism	1
2.4	Taking notes and strategies for organizing notes	2
2.5	Planning and organizing the review of literature	2
UNIT-3	**OPERATION OF RESEARCH**	**16 Periods**
3.1	Different types of surveys	2

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3.2	Exploring research idea and constructing the research	4
3.3	Finding background information and gathering more information on the chosen area	4
3.4	Locating current research on the topic chosen	2
3.5	Interpreting data and graphics	4
UNIT-4	**MANUSCRIPTION OF RESEARCH**	**13 Periods**
4.1	Writing the first draft	3
4.2	Quality and Style of writing	3
4.3	Editing and proof reading	3
4.4	Writing the introduction and conclusion	3
4.5	Summarizing the research paper and preparing title page	1
UNIT-5	**PRESENTATION AND PUBLICATION OF RESEARCH**	**13 Periods**
5.1	Final revision and proof reading	3
5.2	Final presentation	3
5.3	Benefits of publishing an article	1
5.4	How to publish an article	4
5.5	Funding agencies	2

Reference Books:

1. How to write and publish a research paper. Robert A Day, 4th edition, Cambridge University Press, 1995.
2. The Craft of Research. Wayne C Booth, Gregory G. Colomb, Joseph M Williams, The University of Chicago Press, 2008.
3. Engineering Research Methodology, Krishnan Nallaperumal, 2013.
4. How to write a Paper, ed George M Hall, BMJ Publishing Group, 2003.

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U17ENP2103 – English for Competitive Exams

(Common to all branches of Engineering and Technology)

L	T	P	J	C
0	0	4	0	2

Course Objectives:

1. To impart specific training for various Competitive Examinations like IELTS and TOEFL, DEFENCE EXAMS, BANK & LIC EXAMS, CAT etc.
2. To familiarize the learners with online examinations.
3. To improve the writing skills of students through combination of theory and practice for various competitive exams.
4. To create awareness of job prospects in government and defense service.

Course Outcomes:

By the end of the course the students will be able to:

1. Comprehend the necessity of Englishcompetitive exams in the current scenario.
2. Acquire awareness of English content inGovernment serviceand defense service Jobs.
3. Accomplish the prediction skills andinterpretative excellence required for Competitive Exams.
4. Gain ideas on various Competitive exams andmark outtheir own capability.
5. Develop the credibility of competitive spirit.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				M	M				M	M	S			
CO2				M	M				M	M	S			
CO3				S	M				M	M	S			
CO4									M		S			
CO5									M		S			

No	Topic	Hours
UNIT -1 – Various Competitive Exams – An over view – 5 Hrs		
1.1	General over view of various competitive exams	**1**
1.2	Requirements and eligibility for various competitive exams.	**1**
1.3	Introduction to specialized English exams for work or study abroad	**1**
1.4	Scope for engineering graduates in defence service.	**1**
1.5	Pattern and weightage for English in different competitive exams	**1**
UNIT -2 – English Requirement for Higher Education and Work Abroad– 10 Hrs		
2.1	Conversation social / general context – brief presentation	**2**
2.2	Interpretation of data into text	**2**
2.3	Inferring details from conversation / announcements/ information	**2**
2.4	Understanding specific information- Reading long and short passages	**2**

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2.5	Formal and informal Email communication	**2**
UNIT -3 – Verbal Aptitude to Compete – Part I– 10 Hrs		
3.1	Analogy, Cloze test	**2**
3.2	Spot the Error	**2**
3.3	Ordering of Sentences	**2**
3.4	Reading Comprehension	**2**
3.5	Synonyms and Antonyms– One Word Substitutes, Miscellaneous Vocabulary and Spellings	**2**
UNIT -4 – Verbal Aptitude to Compete – Part II– 10 Hrs		
4.1	Verbal Puzzle	**1**
4.2	Idioms and Phrases	**2**
4.3	Essay and Letter	**3**
4.4	Sentence Improvement	**2**
4.5	Fill in the Blanks, Sentence Completion	**2**
UNIT -5 – Training for Competency – 15Hrs		
5.1	Practice Test - I (TOEFL/ IELTS)	**3**
5.2	Practice Test -II (CAT)	**3**
5.3	Practice Test - III (BANK EXAMS)	**3**
5.4	Practice Test - IV(DEFENCE EXAMS / BANK EXAMS)	**3**
5.5	Group Discussion	**3**
Total		**60**

Reference Books:

1. Cambridge BEC Preliminary Book 4, Cambridge University Press, March,2009.
2. Complete IELTs, Guy brook- Hart &VanessaJakeman, Cambridge University Press, March,2009
3. A modern approach to verbal & non-verbal reasoning,Dr.R.SAgarwal, S Chand publications
4. McGraw-Hill Education TOEFL iBT with 3 Practice Tests and DVD-ROM

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SEMESTER 3

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U17MAT3101 PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

(Common to AE/AUE/CE/ME/MEC/EEE)

L	T	P	J	C
3	1	0	0	4

Course Outcomes (COs):

After successful completion of this course, the students should be able to:

CO1: Form partial differential equations and solve certain types of partial differential equations.

CO2: Know how to find the Fourier Series and half range Fourier Series of a function

CO3: To know how to solve one dimensional wave equation, one dimensional heat equation in steady state using Fourier series.

CO4: Apply Fourier series to solve the steady state equation of two dimensional heat equation in Cartesian coordinates.

CO5: Apply the Fourier transform, Fourier sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals..

CO6: Evaluate Z – transform for certain functions. Estimate Inverse Z – transform of certain functions and to solve difference equations using them.

Pre-requisite: NIL

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M			M				M	M		S
CO2	S	M		M								
CO3	S	S	S		S				M	M		S
CO4	S	M	M									M
CO5	S	M	M		S							
CO6	S	S			S				M	M		S

Course Assessment methods:

Direct
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination
Indirect
1. Course-end survey

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PARTIAL DIFFERENTIAL EQUATIONS **9+3 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

FOURIER SERIES **9+3 Hours**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS **5+2 Hours**

Classification of second order quasi linear partial differential equations – Formulation of wave and heat equations using physical laws - Solutions of one dimensional wave equation – One dimensional heat equation (excluding insulated ends)

BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS **4+1 Hours**

Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

FOURIER TRANSFORM **9+3 Hours**

Fourier Integral Theorem – Representation of Functions – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

Z –TRANSFORM **9+3 Hours**

Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform (by using partial fractions, residue methods and convolution theorem) – Solution of difference equations using Z - transform.

Theory : 45 Hours **Tutorial: 15 Hours** **Total:60 Hours**

References:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition. 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand & Company ltd., New Delhi, 2006.
4. Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003.
5. Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2009.

U17AUI3201 **AUTOMOTIVE CHASSIS AND TRANSMISSION**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the construction details of various types of automotive Frames and basic chassis layouts. [K_2]

CO2: Understand the basic function steering system and steering components [K_2]

CO3: Select the appropriate transmission system for various automobiles [K_3]

CO4: Infer the final drive system of a vehicle [K_2]

CO5: Apply the knowledge for selection of suitable axles, wheels and tyres for a vehicle. [K_3]

CO6: Distinguish various types of suspension system, brake system. [K_2]

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M			M		M	M				S	
CO2	S	S	S	W				M	M	W			S	
CO3	S	S	S	M			M	M	M	M			S	
CO4	S	S	S	M									M	
CO5	S	S	M	W		M	S	S	M	W			S	
CO6	M	M	M			M	S	S	M				S	

Course Assessment methods:

Direct	Indirect
1. Assignments/Mini Projects	1. Course Exit Survey
2. Internal Test	
3. End semester Examination	

Frames and Steering System

L
12 Hrs

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, Testing of frames, , Front Wheel Geometry, namely, Castor, Camber, King Pin Inclination and Toe–in, Ackerman's Steering Mechanisms, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power–Assisted Steering.

Transmission and Drive Line

L
12 Hrs

Requirement of transmission system, Different types of gearboxes - Sliding mesh gearbox, Constant mesh gearbox and Synchromesh gearbox. Automatic transmission - Types and Operations. Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube

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drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Multi–axle vehicles, Differential principle and types, Differential housings, Non–Slip differential, Differential locks.

Axles, Wheels and Tyres

L
6 Hrs

Types of Front Axles and Stub Axles, Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles, Axle Housings. Wheels and Rims – Types and constructional details, Tyres – Types and constructional details.

Suspension System

L
6 Hrs

Need for Suspension System, Types of Suspension Springs - Single Leaf, Multi–Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro – elastic Suspension Spring Systems, Boggy suspension system, Independent Suspension System, Shock Absorbers.

Braking System

L
9 Hrs

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Activators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Anti–Lock Braking System.

List of Experiments

P
30 Hrs

1. Measurement of the automotive frames
2. Measurement of steering angle
3. Assessment of Automotive chassis
4. Performance test on suspension test Rig
5. Assessment of wheels and tyres
6. Study of final drive assembly
7. Study of different gearboxes
8. Study of different types of brake systems

Theory :45 Hrs Tutorial: --- Hrs Practical : 30 Hrs Total Hours: 75

References:

1. Tim Gilles, “Automotive Chassis-Brakes, Steering and Suspension”, Thomson Delmer Learning, 2005.
2. Jornsen Reimpell, Helmut Stoll, “Automotive Chassis: Engineering Principles”, Elsevier, 2nd edition, 2001.
3. Newton Steeds and Garret, “Motor Vehicles” 13th Edition, Butterworth, London, 2005.
4. Heinz Hazler, “Modern Vehicle Technology”, Butterworth, London, 2005.
5. Kripal Singh, “Automobile Engineering” ,Standard Publishers,2011
6. R.K. Rajput, “A Text–Book of Automobile Engineering”, Laxmi Publications Pvt.Ltd, 2007.
7. Heldt.P.M, “Automotive Chassis”, Chilton Co., New York,1990.
8. Giles.J.G, “Steering Suspension and tyres”, Iliffe Book Co.,London,1988

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U17AUI3202 **STRENGTH OF MATERIALS**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the basic concepts of stress and strain [K_2]

CO2: Compare the beams of different cross sections for shear force, bending moment & bending stress [K_4]

CO3: Understand and apply the different approaches for calculating slope and deflection for various types of beams [K_3]

CO4: Analyze the shafts and columns with different edge conditions by using different theories [K_4]

CO5: Understand the concepts and theories necessary to design the structural elements and pressure vessels [K_2]

CO6: Apply concepts of strength of materials to obtain solutions to real time Engineering problems [K_6]

Pre-requisite:

Engineering Mechanics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	M							S			S	
CO2	S	S	M	M						S			S	
CO3	S	S	M	M						S			S	
CO4	S	S	M	M						S			S	
CO5	S	S	M	M						S			S	
CO6	S	S	M	S				S		S		S	S	

Course Assessment methods:

Direct	Indirect
1. Assignments/Mini Projects	1. Course Exit Survey
2. Internal Test	
3. End semester Examination	

CONCEPT OF STRESSES AND STRAINS

L
10 Hrs

Concept of stress and strain, Hooke's law – Tension, Compression, and Shear, stress-strain diagram – Poisson's ratio, elastic constants and their relationship – Deformation of simple and compound bars. Thermal stresses – simple and Composite bars. Principal plane, principal stress, maximum shearing stress – Uniaxial, biaxial state of stress – Mohr's circle for plane stresses.

ANALYSIS OF BEAMS

L
9 Hrs

Types of beams and loads – shear force and bending moment diagrams for cantilevers, simply supported and over hanging beams. Theory of pure bending – Bending stresses in simple and composite beams. Shear stress distribution in beams of different sections.

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DEFLECTION OF BEAMS

L
9 Hrs

Slope and deflection of cantilever, simply supported beam by double integration method – Macaulay's method – Moment area method – Castigliano's theorem.

TORSION OF SHAFTS

L
8 Hrs

Theory of pure torsion, derivation of shear stress produced in terms of torque in a circular shaft. Strength, stiffness of shaft and Torsional rigidity & power transmitted – Expression for torque in terms of polar moment of inertia in a circular shaft subjected to torsion – Circular shafts in series and parallel – Circular shaft subjected to combined bending and torsion – Circular shaft subjected to combined bending and torsion – Composite Shaft.

COLUMNS AND CYLINDERS

L
9 Hrs

Columns and struts: Member subjected to combined bending and axial loads, Euler's theory, Crippling load, Rankine's theory.

Cylinders And Shells: Thin cylinder, thin spherical shells under internal pressure – Thick cylinders – Lame's equation – Shrink fit and compound cylinders.

List of Experiments

P
30 Hrs

1. Tension & Shear Test on Mild Steel Rod
2. a) Torsion Test on Mild Steel Rod
   b) Compression Test on Concrete Cube.
3. Hardness Test- Brinell, Vickers and Rockwell Hardness tests
4. Impact Test- Izod, Charpy Impact Tests
5. Test on Helical Springs- Compression and Tension Springs
6. Deflection Test on Beams

Theory: 45 Hrs **Tutorial: 0 Hrs** **Practical: 30 Hrs** **Total Hours: 75**

References:

1. Bansal R.K, "*A Text Book of Strength of Materials*", Lakshmi Publications Pvt. Limited, New Delhi, 2010.
2. William Nash, '*Strength of Materials'*, Tata McGraw Hill, 2004
3. S. Ramamrutham and R. Narayanan, (2011), *Strength of Materials*, Dhanpat Rai Publications, 16th edition.
4. Kazmi, S. M. A., "*Solid Mechanics*" TMH, Delhi, India.
5. Laboratory Manual of Testing Materials - William Kendrick Hall
6. Egor P. Popov, *"Engineering Mechanics of Solids*", 2nd edition, Prentice Hall of India Private Limited, New Delhi, 2009.
7. Ferdinand P. Beer, and RusellJohnston.E, *"Mechanics of Materials"*, SI Metric Edition, McGraw Hill, 2011(Hard cover).
8. Timoshenko, S.P. and Young, D.H., (2011), *Strength of Materials*, East West Press Ltd. 5th edition

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U17AUI3203 **MANUFACTURING TECHNOLOGY**

L	T	P	J	C
3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand the Casting processes used for components manufacturing

CO2: Understand the Forming and Powder metallurgy processes used for manufacturing bulk and Sheet metal components

CO3: Understand the principles of Welding Processes used in manufacturing practices

CO4: Understand the Conventional Machining and Machine tools used for components manufacturing

CO5: Understand the Principles behind the Unconventional machining processes used for components manufacturing

CO6: Understand the Principles behind Forming of Plastics

Pre-requisite:

1. Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W		S		M								S	
CO2	W		S		M								S	
CO3	S		S		M								S	
CO4	S		S		M								S	
CO5	S		S		M								S	
CO6	S		S		M								S	

Course Assessment methods:

Direct	Indirect
1. Continuous Assessment Test	1. Course Exit Survey
2. Assignments	
3. End Semester Examination	

CASTING 9 Hours

Casting types, procedure to make sand mould, types of core, moulding tools, machines used for 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.

FORMING PROCESSES AND POWDER METALLURGY 9 Hours

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning - Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy - Forming and Shaping of Plastics –Types of plastics and Molding Types - Principles of Hydro forming process, its advantages and limitations.

WELDING 9 Hours

Classification of welding processes. Principles of gas welding- Oxy-acetylene- A.C metal arc welding, Resistance welding, Submerged arc welding, Tungsten inert gas welding, Metal inert gas

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welding, Plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding - defects in welding - Soldering and brazing- Application of Welding in Automobile.

MACHINE TOOLS FOR MACHINING **9 Hours**

Introduction to the Lathe, Shaper, Planer, Milling machines, Drilling machines, Cylindrical grinding machine, Capstan and Turret lathe - CNC machines.

UNCONVENTIONAL MACHINING PROCESSES **9 Hours**

Principles and applications of the Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining.

List of Exercises: Machining exercises using Machine Tools

1. LATHE
   - 1.1. Facing, plain turning and step turning
   - 1.2. Taper turning using compound rest.
   - 1.3. Taper turning using taper turning attachment
   - 1.4. Single start V thread, cutting and knurling
2. SHAPER AND SLOTTER
   - 2.1. Machining a V- block (in a Shaper)
   - 2.2. Machining internal key-way (in a Slotter)
3. DRILLING
   - 3.1. Drilling 4 or 6 holes at a given pitch circle on a plate
   - 3.2. Drilling, reaming and tapping
4. MILLING
   - 4.1. Plain Milling Exercise
   - 4.2. Gear Milling Exercise
5. GRINDING
   - 5.1. Cylindrical Grinding Exercise
6. FOUNDRY
   - 6.1 Moulding using single and Split Pattern
7. SMITHY (Hand Forging exercises)
   - 7.1 Making of a Square rod from a round rod
   - 7.2 Making of a Square and Hexagonal head in a round rod

Theory :45 Hrs **Practical : 15 Hrs** **Total Hours: 60**

References:

1. Hajra Choudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2. Nagendra Parashar B.S. and Mittal R.K., “Elements of Manufacturing Processes”, Prentice-Hall of India Private Limited, 2007.
3. Serope Kalpajian, Steven R.Schmid, “Manufacturing Processes for Engineering Materials”, 4/e, Pearson Education, Inc. 2007.
4. R.K.Jain and S.C. Gupta, “Production Technology”, Khanna Publishers. 16th Edition, 2001.
5. “H.M.T. Production Technology – Handbook”, Tata McGraw-Hill, 2000.
6. Roy. A. Linberg, “Process and Materials of Manufacture”, PHI, 2000.
7. M. Adithan and A.B. Gupta, “Manufacturing Technology”, New Age, 2006
8. Fundamentals of Metal Cutting and Machine Tools, B.L.Juneja, G.S.Sekhon, Nitin Seth, New Age International (P) Limited ,Publishers, 2005
9. Modern Machining Processes, P. C. Pandey, H. S. Shan, Tata McGraw-Hill Education, 1980
10. Nontraditional Manufacturing Processes, Gary F. Benedict, Marcel and Decker,2017

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U17AUT3104 **THERMODYNAMICS AND THERMAL ENGINEERING**

L	T	P	J	C
3	1	0	0	4

(Use of standard Steam tables with mollier chart, HMT Data book and Refrigerant tables are permitted)

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Understand Thermodynamic laws and their applications. [K_2]

CO2: Apply energy balance to systems and control volumes, in situations involving heat and work interactions [K_4]

CO3: Differentiate between high grade and low grade energies [K_2]

CO4: Understand Properties of steam. [K_2]

CO5: Integrate the basic concepts into various thermal applications like air compressor, refrigeration and air conditioning. [K_5]

CO6: Enlighten the various mode of heat transfer and their engineering application [K_3]

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S											S	
CO2	S	S		S									S	
CO3	S	S												
CO4	S	S												
CO5	S	S											S	
CO6	S	S											S	

Course Assessment methods:

Direct

1. Assignments
2. Internal Test
3. Group Presentation
4. End semester Examination

Indirect

1. Course Exit Survey

FIRST LAW OF THERMODYNAMICS

L	T
8 Hrs	3 Hrs

System, thermodynamic equilibrium, state, property, process, cycle, energy, work, heat, first law of thermodynamics, PMM I, ideal gases, steady flow energy equation and application of first law of thermodynamics to closed and open systems. Simple Problems.

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SECOND LAW OF THERMODYNAMICS

L	T
7 Hrs	2 Hrs

Statements of second law of thermodynamics, heat engine, heat pump, refrigerator, carnot cycle, carnot theorem, entropy and entropy changes for a closed system.

AIR STANDARD CYCLE AND COMPRESSOR

L	T
8 Hrs	2 Hrs

Otto, Diesel, and Brayton cycles - Concepts and applications, simple problems. Compressors, Classifications of compressors, Single stage and multi stage, intercooler in multi stage compressor.

PROPERTIES OF STEAM AND VAPOUR POWER CYCLE

L	T
6 Hrs	2 Hrs

Steam formation, properties of steam. Use of steam tables and Mollier chart, Ideal Rankine cycle, Reheat and regenerative cycle Rankine cycle. Simple problems.

PSYCHROMETRY, REFRIGERATION AND AIR CONDITIONING

L	T
8 Hrs	3 Hrs

Properties of atmospheric air, Psychrometric relations, Psychrometric Processes and chart. Principles of refrigeration, Types - Vapour compression and Vapour absorption types – Coefficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning. Introduction to Automotive air conditioning systems. Simple Problems.

HEAT TRANSFER

L	T
8 Hrs	3 Hrs

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Basics of Convective heat transfer. Fundamentals of Radiation heat transfer. Flow through heat exchangers, Types and Performance evaluation – Parallel and counter flow. Simple Problems.

Theory :45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

References:

1. Nag .P.K, "*Engineering Thermodynamics"*, 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. Yunus A Cengel, "Heat and Mass Transfer – A Practical Approach", Tata McGraw Hill, New Delhi, 2007.
3. Rajput R.K, "*Thermal Engineering"*, Laxmi Publications, 10 th Edition, New Delhi, 2015.
4. Yunus.N.J, Cengel.A, and Michael Boles, "A., Thermodynamics – An Engineering Approach, 8th Edition", Tata McGraw Hill- Education, 2015
5. Kothandaraman.C.P, Domkundwar.S, Anand Domkundwar, "A Course in Thermal Engineering", Dhanpat Rai & Co. (P) Ltd., 2010.
6. Mahesh M. Rathore, "Thermal Engineering", Tata Mc Graw Hill Education private limited, Reprint 2012.

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U17INI3600 **ENGINEERING CLINIC - I**

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	S	S	S	S			S	S	S
CO2								S	S	S	S		M	M
CO3								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Workbook report	
3. Demonstration & Viva-voce	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the third semester, students will focus primarily on IOT with C programming using Audino.

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP3503 **FAMILY VALUES** (Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop skills in maintaining the harmony in the family.
CO 2: Create impulsive activities for healthy family
CO 3: Be receptive to troubled Individuals
CO 4: Gain healthy life by practicing Kundalini Yoga & Kayakalpa
CO 5: Possess Empathy among family members.
CO 6: Reason the life and its significance

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									S			
CO2							M					
CO3										M		
CO4												S
CO5						S						
CO6								M				

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Family system: Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
2. Peace in Family : Family members and their responsibility - Roles of parents, children, grant parents -. Respectable women hood
3. Core value: Empathy: Unconditional love - Respect - Compassion - sacrifice–Care &share - helping – emotional support- hospitality – cleanliness
4. Blessing: Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.

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5. Healthy Family: Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

Workshop mode

REFERENCES

1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf

2. FRAMEWORK FOR ACTION ON VALUES EDUCATION IN EARLY CHILDHOOD – UNESCO – PDF – www.unesdoc.unesco.org/images/0012/001287/128712e.pdf

3. TRUE FAMILY VALUES Third Edition - Tparents Home www.tparents.org/Library/Unification/Books/TFV3/_TFV3.pdf

4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf

5. PROBLEMS OF INDIA'S CHANGING FAMILY AND STATE ... - the United Nations - www.un.org/esa/socdev/family/docs/egm09/Singh.pdf

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U17CHT3000	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All branches)	L	T	P	C
		3	0	0	0

Course Outcomes

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.

CO 3: Highlight the importance of ecosystem and biodiversity.

CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play an important role in transferring a healthy environment for future generations.

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		M					S		M			
CO 2						M				M		
CO 3							M					
CO 4						M	S					
CO 5							S					
CO 6			W				S					M

Course Assessment methods

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End Semester Exam	Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **14 Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.

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Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY **9 Hours**

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **8 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT **7 Hours**

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Hours **Total: 45 Hours**

REFERENCES

1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.
3. Bharucha Erach, 'The Biodiversity of India', Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.

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4. Trivedi R.K and P.K.Goel, 'Introduction to Air Pollution', Techno-Science Publications, 2003.
5. Trivedi R.K., 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, 'Environmental Encyclopedia', Jaico Publication House, Mumbai, 2001.
7. Wager K.D., 'Environmental Management', W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, 'Essentials of Ecology', Third Edition, Blackwell Publishing, 2008.

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SEMESTER 4

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U17MAT4101

NUMERICAL METHODS AND PROBABILITY

(Common to AE/AUE/CE/ME/MCE/EEE)

L	T	P	J	C
3	1	0	0	4

COURSE OUTCOMES

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

- **CO1:** Apply various numerical techniques for solving non-linear equations and systems of linear equations.
- **CO2:** Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
- **CO3:** Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.
- **CO4:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
- **CO5:** Apply the concepts of probability to random variables.
- **CO6:** Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												
CO2	S	S												
CO3	S	S							M					
CO4	S	S												
CO5	S	S							M					
CO6	S	S												

COURSE ASSESSMENT METHODS

Direct

1. Continuous Assessment Test I, II
2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable)
3. End Semester Examination

Indirect

1. Course-end survey

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SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS **9+3 Hours**

Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigenvalues of a matrix by Power method.

INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3 Hours

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3 Hours

Single step methods: Taylor's series method – Euler and Improved Euler methods for solving a first order equations – Fourth order Runge-Kutta method for solving first and second order equations – Multistep method: Milne's predictor and corrector method.

BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9+3 Hours

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain–Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

PROBABILITY AND RANDOM VARIABLES **9+3 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function- Probability density function – moments - Binomial, Poisson and Normal distributions – Properties.

Theory: 45 Hours **Tutorials: 15 Hours** **Total: 60 Hours**

REFERENCES

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 2007.
3. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 7th Edition, Tata McGraw-Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition, 2017.
6. Gupta S.C, and Kapur V.K "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4th Edition, 2014.

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U17AUI4201 **AUTOMOTIVE ENGINES AND SYSTEMS**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:
Impart knowledge on IC engines and its subsystems for understanding their role in automobiles.
Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the various components of the engine and its functions.
CO2: Examine the combustion process in SI and CI Engine for understanding the performance and emission characteristics.
CO3: Summarize various fuel supply and injection system used in IC engines.
CO4: Identify the suitable lubrication and cooling system to be used in IC Engines.
CO5: Explain the concepts of Supercharging and Turbocharging.
CO6: Analyze the various properties of fuels used in I.C engines.

Pre-requisite:
1 U17AUT3104 - Thermodynamics and Thermal Engineering

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S		S			S	S	M		M				S
CO2:	S		S			S	S	S	M	S				S
CO3:	S		S			M		M		M				M
CO4:	M		S			M		M		M				S
CO5:	S		S			S	M	M		M				M
CO6:	S		S			S	S	S		S				S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

ENGINE CONSTRUCTION AND ITS COMPONENT **L: 9 Hrs**
Four stroke SI and CI engines – Working principle- Constructional details of engine components, function, materials, Intake system components - Discharge coefficient, Pressure drop Air filter, intake manifold, Connecting Pipe, Exhaust system components – Exhaust manifold and exhaust pipe, Spark arresters - Exhaust mufflers, Types, operation.

COMBUSTION IN SI ENGINES **L: 12 Hrs**
Combustion process in IC engines, Stages of combustion, Flame propagation Flame velocity and area of flame front - Rate of pressure rise - Cycle to cycle variation, Abnormal combustion - Theories of detonation -Effect of engine operating and design variables on combustion, Combustion chambers – types, factors controlling combustion chamber design. Gasoline injection Systems

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COMBUSTION IN CI ENGINES **L: 12 Hrs**

Importance of air motion – Swirl, squish and turbulence – Swirl ratio. Fuel air mixing – Stages of combustion – Delay period – Factors affecting delay period, Knock in CI engines – methods of controlling diesel knock. CI engine combustion chambers – Combustion chamber design objectives – open and divided. Induction swirl, turbulent combustion chambers. – Air cell chamber – M Combustion chamber, Diesel injection system.

LUBRICATION AND COOLING SYSTEM **L: 3 Hrs**

Need for cooling system – Types of cooling system – Liquid cooled system: Thermosyphon system, Forced circulation system, pressure cooling system – properties of coolant, additives for coolants Need for lubrication system – Mist lubrication system, wet sump any dry sump lubrication – Properties of lubricants, consumption of oil.

SUPERCHARGING AND TURBOCHARGING **L: 9 Hrs**

Objectives – Effects on engine performance – engine modification required – Thermodynamics of supercharging and Turbocharging – Turbo lag-Windage losses- Turbo charging methods – Engine exhaust manifold arrangements.

Practical

List of Exercises : **P: 30 Hrs**

1. Dismantling and Assembly of Engine components.
2. Experimental investigation on performance and emission characteristics of Twin cylinder C.I engines
3. Experimental Investigation on Performance, combustion and emission characteristics of Single cylinder D.I Diesel engines
4. Heat Balance Test on Automotive Engine
5. Experimental investigation on performance and emission characteristics of Multi cylinder S.I engines
6. Study on CRDI and MPFI fuel injection system.
7. Flash and fire point of fuels
8. Cloud and pour point test
9. Calorific value of liquid and gaseous fuel
10. Viscosity of fuels, Lubricants
11. Drop point of grease and mechanical penetration in grease.

Theory : 45 Hrs	Practical: 30 Hrs	**Total Hours: 75**

References:

1. "*Internal combustion engines*", Ganesan V, 4th edition, Tata McGraw Hill Education, 2017.
2. IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
3. "A textbook of Internal Combustion Engines - Rajput R. K, 2nd edition, Laxmi Publications (P) Ltd, 2017.
4. "*Internal Combustion Engine Fundamentals*", John. B, Heywood, McGraw Hill Publishing Co., New York, 2017.
5. *Internal Combustion Engines and Air Pollution* Edward F, Obert,*"*, Intext Education Publishers, 1980.
6. Mathur and Sharma, "*A course on Internal combustion Engines*", Dhanpat Rai & Sons, 2015.

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U17AUI4202 **FLUID MECHANICS AND MACHINERY**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:
To understand the fundamental concepts of fluid flow and its application in flow measurement devices, pipes and hydraulic machines.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the properties of the fluid, flow concepts and measuring devices
CO2: Apply the fluid flow concepts and solve the problems
CO3: Analyse the practical flow problems using mathematical techniques
CO4: Apply the laws of conservation in flow through pipes
CO5: Illustrate the working principles of hydraulic machines
CO6: Correlate the Fluid Mechanics principles by performing laboratory experiments.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M	M									M		
CO2:	S	M	M									M	M	
CO3:	S	M	M									M	M	
CO4:	S	M	M									M	M	
CO5:	M											M		
CO6:	S	M	M						M			M	M	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

PROPERTIES OF FLUIDS AND FLUID STATICS **L: 9 Hrs**
Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law – Pressure head, Pascal's law. Measurement of pressure – Piezometric tube, manometry.

FLUID KINEMATICS AND FLUID DYNAMICS **L: 12 Hrs**
Fluid kinematics: Lagrangian and Eulerian description of fluid flow – Velocity and acceleration of fluid particles – Different types of fluid flow. Description of flow pattern: Stream line, streak line, path line. Principle of conservation of mass – Continuity equation.

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Fluid dynamics: Euler's equation of motion along a streamline – Bernoulli's equation. Practical applications of Bernoulli's equation in flow measurement devices like venturimeter, orificemeter and pitot tube. Concept of impulse momentum equation & angular momentum principle with applications.

DIMENSIONAL AND MODEL ANALYSIS **L: 9 Hrs**

Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham π theorem. Model analysis – Advantages and applications of model testing. Similitude, derivations of important dimensionless numbers, model laws.

FLOW THROUGH PIPES **L: 9 Hrs**

Laminar and turbulent flow characteristics, laminar flow through circular pipes – Hagen Poiseuille law, Turbulent flow – development of Darcy – Weisbach equation, major and minor losses in pipes, Flow through pipes in series and parallel.

HYDRAULIC MACHINES **L: 6 Hrs**

Hydraulic turbine: Classification, difference between impulse and reaction turbine. Construction and working of Pelton turbine, Francis turbine and Kaplan turbine.

Pumps: classification, difference between positive and non-positive displacement pumps. Construction and working of reciprocating pump and Centrifugal pump.

Practical

List of Exercises : **P: 30 Hrs**

1. Verification of Bernoulli's theorem
2. Determination of Darcy's friction factor
3. Determination of coefficient of discharge of Venturimeter
4. Determination of coefficient of discharge of Orificemeter
5. Determination of coefficient of discharge of notches
6. Determination of coefficient of discharge of mouthpiece/Orifice
7. Performance study on centrifugal pump
8. Performance study on gear oil pump/Reciprocating Pump
9. Load test on Pelton wheel turbine
10. Load test on Francis tubine
11. Load test on Kaplan turbine

Theory : 45 Hrs	Practical: 30 Hrs	**Total Hours: 75**

References:

1. "Fluid mechanics and hydraulic machines", R.K. Bansal, Laxmi Publications (P) Ltd, Tenth edition, 2018.
2. "Hydraulics and Fluid Mechanics", Modi P.N. and Seth S.M., Standard Book House, New Delhi, 21 edition, 2018.
3. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Introduction to Fluid Mechanics", Wiley, 8th Edition, 2013.
4. Frank M.White, "Fluid Mechanics", McGraw-Hill, 7th Edition, New Delhi, 2011.
5. Irving H. Shames, "Mechanics of Fluids", McGraw Hill, 3rd Edition, 2013.

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U17AUI4203 **MACHINE DRAWING**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:
To make the students to understand the concepts of I.S. conventions, methods of dimensioning and sectioning, to draw part and assemble drawings using drawing instruments and software tools.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Interpret the conventional representation of components
CO2: Construct part drawings with required views and dimensions
CO3: Apply the knowledge of Limits, Fits and Tolerances in the drawings.
CO4: Build part and assembly drawings according to BIS with Bill of Materials
CO5: Identify and draw the different types of Screwed Fastenings.
CO6: Make use of CAD software to model and draft components and assemblies.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S		M		S			M	M	S		M	S	
CO2:	S	M	S	M	S			M	S	S		M	S	
CO3:	S	M	S	M	S	W		S		S			M	S
CO4:	M	S	S		S			M	S	S			S	
CO5:	M	M	M		S			M	M	S			S	
CO6:	M	S	S		S			M	S	S			S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

Introduction **L: 3 Hrs**
Need of Graphical Language, Importance Machine Drawing
Classification of Machine Drawings:
Part Drawing and Assembly Drawing

Sectioning **L: 3 Hrs**

Conventional Representations **L: 7 Hrs**
Standard parts and Screwed Fastenings.

Limits, Fits, Dimensional and Form Tolerances **L: 9 Hrs**
Definitions, Classifications of Fits, System of Fits, Selection of Fits, Method of Indicating Fits on Drawings, Tolerance Grade, Positions of Tolerance, Form Tolerance, Fundamental of Deviations, Shaft and Hole Basis systems, Method of Placing Limit Dimensions

Part and Assembly Drawings **L: 8 Hrs**
Introduction, BOM and its Importance, Assembly procedures

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Practical

List of Exercises : (Any Five to be practiced) **P: 30 Hrs**

1. Part and Assembly Drawing of Screw Jack
2. Part and Assembly Drawing of Knuckle Joints
3. Part and Assembly Drawing of Universal coupling
4. Part and Assembly Drawing of Lathe Tail Stock
5. Part and Assembly Drawing of Gear Pump
6. Part and Assembly Drawing of Crankshaft with connecting road and piston
7. Part and Assembly Drawing of Single Plate Clutch

Theory : 30 Hrs	Practical: 30 Hrs	**Total Hours: 60**

References:

1. Machine Drawing Textbook By ND Bhatt – 53rd Edition 2016
2. Machine Drawing- P.S. Gill, S.K. Kataria & Sons, 17 th Edition, 2012.
3. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers, 4 th Edition, 2012.
4. "Machine Drawing", Gopalakrishnan.K.R, Subash Publishers, Bangalore, 2000.
5. N. D. Junnarkar , "Machine Drawing", Pearson India, 2006
6. Technical Graphics Communication (IRWIN Graphic Series), Bertoline, Wiebe, Miller, Nasma., Richard D Irwin; 2nd edition (June 1997)

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U17AUT4004 **VEHICLE BODY ENGINEERING**

L	T	P	J	C
3	0	0	0	3

Course Objective:
Impart knowledge for the construction of vehicle with light weight, improved aerodynamics and body trims in accordance with safety regulations.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Classify the vehicles and define basic terminologies.
CO2: Select appropriate body material for automobiles.
CO3: Calculate various aerodynamic forces and moments acting on vehicle.
CO4: Examine the various loads distribution in vehicle frames.
CO5: Familiarize the ergonomics concepts related to the vehicles.
CO6: Apply various safety aspects as per the norms.

Pre-requisite:
1 U17AUI3201 - Automotive Chassis and Transmission

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	W				M						M	M	
CO2:	S	M	M			M	M	M		M		M	S	
CO3:	S	S	S	M			M	M	M	M			S	
CO4:	S	S	S	S				M	M	M			S	
CO5:	M	W	W			S		M					M	
CO6:	M	W	S			S		M	M	M		M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

VEHICLE BODY DETAILS **L: 7 Hrs**
Body Terminologies, Vehicle body construction techniques, BIW, Regulations, Drivers visibility - Methods for improving visibility and space in cars, Seat – dimensions & parameters, Types of loads, Frame design and bending - Idealized structure, surface, crash worthiness, vehicle safety - Crash and Roll Test.

VEHICLE AERODYNAMICS **L: 8 Hrs**
Aerodynamics – concept, objectives, Forces and Moments – types and effects on vehicle body, Body optimization techniques for minimum drag and lift. Wind tunnel testing – concept – types - test setup - testing process - Flow visualization techniques - Scale model testing - Component balance to measure aerodynamic forces

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CAR BODY DETAILS **L: 8 Hrs**

Classifications – Hatchback, Saloon, Convertibles, Limousine, Estate Van, SUV, Racing and Sports Car – Car body construction Driver seat design – Car body panels, windows, doors, locks – remote and central locking - Safety aspect of car body.

BUS BODY DETAILS **L: 8 Hrs**

Types: Mini bus, single decker & double decker, two level, split level and articulated bus, bus body layout, floor height, engine location, entrance and exit locations, passenger seating dimensions, seat layout for RTO registration, constructional details, frame construction, double skin construction, conventional and integral coach type construction. Bus body Code Regulations (ARAI). Pneumatic equipment for passenger door opening & closing. Air conditioning equipment selection and mounting.

COMMERCIAL BODY DETAILS **L: 7 Hrs**

Types of body, flat platform, drop side, fixed side, tanker body, tipper body - designs, volume/weight considerations, pay load and related regulations, light commercial vehicle body types. Dimensions of driver's seat in relation to controls, drivers cab design.

BODY MATERIALS AND MECHANISMS **L: 7 Hrs**

Types of materials used in body construction - steel sheet, timber, plastics, GRP, FRP - properties of materials. Body trim items - body mechanisms. body repair - body fillers - passenger compartment service – corrosion – types, anticorrosion methods, modern painting process procedure - paint problems, dash board - instrument panel, audio – visual systems.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1. Body Engineering Design and Construction of Motor Vehicle Bodywork - Sydney F page., Chapman & Hall Ltd, London, 1967
2. Vehicle Body Engineering - Giles J Pawlowsky., Business books limited, 1989
3. Vehicle Body Layout and Analysis - John Fenton., Mechanical Engg. Publication ltd, London, 1980
4. Vehicle Body Building and Drawing - Braithwaite, J.B., Heinemann Educational Books Ltd., London, 1997
5. The Passenger Car Body - Dieler Anselm., SAE International and Vogel Verlag, 2000
6. Materials for Automobile Bodies - Geoff Davies., Butterworth-Heinemann, 2012
7. The Repair of Vehicle Bodies - A. Robinson, W. A. Livesey., Butterworth-Heinemann Ltd, 2018
8. Aerodynamics of Road Vehicles - Wolf-Heinrich Hucho., Published by SAE International, USA, 1998
9. Vehicle Aerodynamics - Dr. V. Sumantran and Dr. Gino Sovram., SAE International, USA, 1994
10. Automotive Chassis & Body - P. L. Kohli., Papyrus Publishing House, New Delhi.
11. Automotive Chassis - Crouse W. H. &Anglin D. L., McGraw-Hill Int. Book Co.

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U17INI4600 **ENGINEERING CLINIC - II**

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. U17INI3600 - Engineering Clinic - I

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	S	S	S	S			S	S	S
CO2								S	S	S	S		M	M
CO3								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Workbook report	
3. Demonstration & Viva-voce	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on solid modelling and Python programming.

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP4504 **PROFESSIONAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop the ethical values in both professional and personal life
CO 2: Develop ability to take decision to reinforce professional life
CO 3: Rational in professional skills required for diverse society
CO 4: Excel in ingenious attitude to congregate professional life
CO 5: Research into the professional stand
CO 6: Spruce an Individual with decorum to achieve professional life

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								S				
CO2				M								
CO3			S									
CO4												S
CO5								M				
CO6										M		

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1.Professional skills With Values: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence

2.Building Innovative work cultures: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making

3.Professional Work Ethics: Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility

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4.Engineering Ethics: Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures

5.Case studies in engineering ethics: Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

Workshop mode

REFERENCES

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
   www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS
   www.garda.ie/Documents/User/declarationvalues.pdf

3. KARMA YOGA - SWAMI VIVEKANANDA
   www.vivekananda.net/PDFBooks/KarmaYoga.pdf

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering
   www.sasurieengg.com/.../GE2025%20Professional%20Ethics%20in%20Engineering.

5. ENGINEERING ETHICS CASE STUDY; Challenger
   www.ucc.ie/en/processeng/staff/academic/ebyrne/.../PE1006PptNotesLect7.pdf

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U17INT4000 **CONSTITUTION OF INDIA**
(Mandatory course)

L	T	P	J	C
2	0	0	0	0

Course Outcomes:

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

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites : NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M			W			S
CO2						S		S				M
CO3									M	S		W
CO4								W	M			M
CO5						M		M				S
CO6												

Course Assessment methods

Direct
3. Group Activity / Quiz/ Debate / Case studies 4. Class test / Assignment
Indirect
Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution **4 hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module.2: Fundamental Rights **8 hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

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Module.3: Federal Structure **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4: Amendment to Constitution **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5: Emergency Provisions **4 hours**

National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India

Total **30 hours**

Theory: 30	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 30 hours**

REFERENCES

1. Constitution of India - Ministry of Law & Justice – PDF format
   awmin.nic.in/coi/coiason29july08.pdf

2. Introduction to the Constitution of India by Durgadas Basu

5. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html

4. Parliament of India – PDF format
   download.nos.org/srsec317newE/317EL11.pdf

5. The Role of the President of India – By Prof.Balkrishna

6. Local Government in India – E Book - Pradeep Sachdeva
   https://books.google.com/books/.../Local_Government_in_In..

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SEMESTER 5

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U17AUI5201

AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	J	C
3	0	2	0	**4**

Course Objective:
To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Distinguish the various basic electrical and electronics systems of an automobile.
CO2: Select a battery, starter motor, lamps etc for a suitable application
CO3: Recognize and understand the different wiring diagrams used in automobile manuals.
CO4: Build a simple automobile electrical systems.
CO5: Perform simple programs with the 8085 microprocessor.
CO6: Apply the fundamental concepts of electronics for designing a 9/12V power supply.

Pre-requisite:
1 Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S											M		M
CO2:					M							M		S
CO3:			M									W		
CO4:			M											S
CO5:	S				W							W		M
CO6:	S	M	S						M					S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Model Practical Examinations		
3	Continuous Assessment Tests		
4	End-Semester Examination		

TYPES OF BATTERIES L: 9 Hrs

Batteries – types, construction and working principle of Lead Acid Battery, Nickel – Cadmium Battery, Nickel Metal Hydride Battery, Sodium Sulphur Battery and Aluminum air Battery, lithium ion batteries, Characteristics of batteries, battery rating, capacity and efficiency, Various Tests on battery, battery – charging techniques, maintenance of batteries.

STARTING AND CHARGING SYSTEM L: 9 Hrs

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators- construction and Characteristics, Voltage and Current Regulation, Cut –out relays and regulators, charging circuits

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IGNITION SYSTEM **L: 9 Hrs**

Components and working of Battery Coil and Magneto–Ignition System, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs –construction, working and types, Electronic Ignition System, Distributor–less Ignition System, Digital Ignition System

FUEL INJECTION SYSTEM **L: 9 Hrs**

Introduction, electronic fuel carburetion, fuel injection- types and system overview, components of fuel injection system, diesel fuel injection – introduction of diesel fuel injection, diesel exhaust emissions, electronic control of diesel injection

WIRING, LIGHTING AND OTHER INSTRUMENTS **L: 9 Hrs**

Automotive electrical wiring, terminals and switching, multiplexed wiring system, electromagnetic compatibility(EMC), Lighting system – basic lighting system, Head Lamp and Indicator Lamps, Anti–Dazzling and Dipper system

Practical

List of Exercises : **P: 30 Hrs**

Automotive Electrical Laboratory

1. Testing of Batteries and Battery maintenance
2. Load Test on Starter motors and Alternators
3. Diagnosis of Ignition system
4. Study of Automotive Electrical Wiring
5. Study of Power Window

Automotive Electronics Laboratory

6. Study of rectifiers
7. Study of 555 timer
8. Study of Logic gates
9. Micro Processor programming and interfacing
10. Design of power supply

Theory :45 Hrs	Tutorial: 30 Hrs	**Total Hours: 75**

References:

1. Tom Denton, Automotive Electrical and Electronic Systems, Burlington, MA 01803, Elsevier Butterworth-Heinemann,2004
2. Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press,1999
3. Kholi .P.L.Automotive Electrical Equipment, Tata McGraw-Hill co ltd, New Delhi,2004
4. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book CoInc. NewYork, 2005.
5. Judge.A.W.Modern Electrical Equipments of Automobiles, Chapman & Hall, London 2004 .
6. Robert Bosch, Automotive Handbook, Bently Publishers,2004

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U17AUI5202 **FINITE ELEMENT ANALYSIS**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:

This course focuses on the fundamentals concepts and formulation of the finite element method for solving engineering problems arising in structural mechanics & heat transfer.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Recognize the concepts of finite element method.
CO2: Formulate finite element techniques for design problems
CO3: Devise equations in finite element analysis for 1D, 2D and 3D problems.
CO4: Analyze and solve problems in heat transfer and structural mechanics
CO5: Familiarise a CAE software, to simulate engineering problems in heat transfer and structural mechanics
CO6: Apply finite element techniques for Non Linear Analysis.

Pre-requisite:

1 U17MAT4101- Numerical Methods and Probability

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M	M	M	S							M	S	
CO2:	S	M	M	M	S							M	M	
CO3:	S	M	S	M	S							M		
CO4:	S	M		M	S							M	M	
CO5:	M		M	M	S							M	S	
CO6:	S	M	M	M	S							M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		
4	Model Practical Examination		

FINITE ELEMENT METHODS **L: 9 Hrs**

Historical background , Relevance of FEA to design problems, Application to the continuum, Discretization – Matrix approach, Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method, Galerkin method.

ONE DIMENSIONAL PROBLEMS **L: 9 Hrs**

Finite element modeling – Coordinates and shape functions – Potential energy approach–Element matrices and vectors – Assembly for global equations – Boundary conditions – Higher order elements – 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 – Solution to problems– Examples.

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TWO DIMENSIONAL PROBLEMS **L: 9 Hrs**

Finite element modeling – CST element, Shell – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer – Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solution examples

HEAT TRANSFER ANALYSIS **L: 9 Hrs**

Basic differential equations of heat transfer, one dimensional and two dimensional finite element formulation using variational method, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples

ISOPARAMETRIC FORMULATION **L: 5 Hrs**

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.

NON LINEAR ANALYSIS **L: 4 Hrs**

Introduction, Non-linear differential equation, Solution procedures for non-linear problems Material non-linearity-analysis of axially loaded bars. Introduction to geometric nonlinearity.

Practical

List of Exercises : **P: 30 Hrs**

1 Structural analysis of frames using Truss Elements
2 Static Structural Analysis using 2D Elements
3 Heat Transfer Analysis using 1D Elements
4 Heat Transfer Analysis using 2D Elements
5 Buckling Analysis of Connecting rod
6 Torsional Analysis of bar using 3D Analysis
7 Dynamic Analysis of Leaf and Coil springs
8 Material Non linearity of Axially loaded bars

Theory : 45 Hrs	Practical: 30 Hrs	**Total Hours: 75**

References:

1 "Introduction to Finite Elements in Engineering", Chandrupatla T R and Belegundu A D , Pearson Education, New Delhi, 2015
2 "A First Course in the Finite Element Method", Logan D L, Thomson Learning, 2012.
3 "A Text book on Finite Element Analysis", Seshu P, Prentice Hall of India, New Delhi, 2003.
4 JN Reddy
5 "The Finite Element Method in Engineering", Rao S S, Elsevier, 2005.
6 "Finite Element Analysis in Engineering Design", Rajasekaran S, S Chand, 2008

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U17AUT5103 **DESIGN OF MACHINE ELEMENTS**

L	T	P	J	C
3	1	0	0	**4**

(Use of PSG design data book is allowed)

Course Objective:

To impart knowledge on theory and design of machine elements and train them in solving design problems involving common machine elements.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Familiarize and apply the design morphology in designing various machine element
CO2: Selecting suitable material for the machine elements
CO3: Calculate and analyze the forces acting on the Machine element
CO4: Choosing the appropriate machine element for the required function
CO5: Designing a machine element from the given data
CO6: Justify the design and present it in an effective manner

Pre-requisite:

1 U17AUI3202- Strength of Materials

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M	M						M	M			M	
CO2:	S	S	S							M			S	
CO3:	S	S												
CO4:	S	S								M		M	S	
CO5:	S	S	S						M	M		M	S	
CO6:	S	S	S						M	M		M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

L: 9 Hrs T: 3 Hrs

INTRODUCTION

Introduction to design and machine elements and, Classification of design – Selection of materials – Factors of safety in design – Endurance limit of materials – Determination of endurance limit for ductile materials.

DESIGN OF SHAFTS AND SPRINGS **L: 9 Hrs T: 3 Hrs**

Introduction – Material and design stresses – Design of axles – Design of shafts on the basis of strength – Design of shaft on the basis of rigidity – Design of hollow shafts – Design of close coiled helical spring subjected to axial loading – Torsion of helical springs.

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GEAR DESIGN **L: 9 Hrs T: 3 Hrs**

Design considerations – strength of gear teeth – Lewis equation – Terminology of gears Dynamic tooth load – Design of spur gears – helical gears – bevel gears and worm Gears.

DESIGN OF BEARINGS **L: 9 Hrs T: 3 Hrs**

Design of journal bearings – Ball and Roller bearings – Types of Roller bearings – Bearing life – Static load capacity – Dynamic load capacity – Bearing material – Boundary lubrication – Oil flow and temperature rise.

FLYWHEELS **L: 9 Hrs T: 3 Hrs**

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

Theory : 45 Hrs	Tutorial: 15 Hrs	**Total Hours: 60**

References:

1 " Fundamentals of Machine Elements", Bernard J Hamrock, Tata McGraw Hill, 2004
2 " Design of Machine Elements " Bhandari V B , Tata McGraw Hill, 1990
3 "Material selection in mechanical design" Michael F ashby, Butterworth-Heinemann,2001
4 "Machine Design", U C Jindal, Pearson,2010.
5 " A textbook of Machine Design" , R S Khurumi, Eurasia Publishing House.2005
6 "Mechanical Engineering Design" Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett, 9th Edition, Tata McGraw-Hill, 2011.
7 "Machine Design", Sundararajamoorthy T. V. Shanmugam .N, Anuradha Publications, Chennai, 2015.

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U17AUT5104 **MECHANICS OF MACHINES**

L	T	P	J	C
3	1	0	0	**4**

Course Objective:
Understand the mechanisms of mechanical systems and analyze the forces and motions.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Calculate the velocity and acceleration of simple mechanisms.
CO2: Create the cam profile for different follower motions.
CO3: Identify the different gear trains and calculate the gear ratio.
CO4: Solve and draw the plots for the static and dynamic balancing of various mechanical systems.
CO5: Evaluate the free and forced vibrations for different applications.
CO6: Summarise the kinematic aspect of the mechanisms in automotive applications

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S							S			S	
CO2:	S	S	M	M				M	M	S			S	
CO3:	S	S	S	M									M	
CO4:	S	S	M					M		S			M	
CO5:	S	S	S	M		W	W	M					S	
CO6:	S	S	M	W				M		M		S	M	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

BASICS OF MECHANISMS **T: 9 Hrs T: 3 Hrs**
Machine Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Kinematic analysis of simple mechanisms –Four bar mechanisms Slider crank and crank rocker mechanisms - Inversions –Applications– Velocity and Acceleration diagram – Calculation of simple four bar and slider crank mechanism using relative velocity method.

DESIGN OF CAM PROFILE **T: 9 Hrs T: 3 Hrs**
Types of cams, Types of followers, Radial cam, Terminology of radial cam, Types of follower motions: uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion, Cam profile for knife edge, Roller and flat faced follower – Graphical method (Mushroom)

KINEMATICS OF GEAR TRAINS **T: 9 Hrs T: 3 Hrs**
Gear profile and geometry – Nomenclature of spur and helical gears, Classification of gear trains, Calculation of Gear ratio, Number of teeth for the gears in the gear trains, Velocities of the gears in gear

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trains such as Simple, Compound, Reverted and Epicyclic (using tabulation method) gear trains, Differential gear train.

BALANCING **T: 9 Hrs T: 3 Hrs**

Static and dynamic balancing – Single and several masses in different planes - Whirling of shafts– Critical speed of shafts - Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi-cylinder engines (Inline) – Balancing of radial V engine – Direct and reverse crank method

VIBRATIONS **T: 9 Hrs T: 3 Hrs**

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.

Theory : 45 Hrs	Tutorial: 15 Hrs	**Total Hours: 60**

References:

1 Theory of Machines and Mechanisms - Shigley J.E., Pennock G.R., Uicker J.J., 5th Edition, Oxford University Press, 2017.
2 Theory of Machines - Rattan S.S., Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2014.
3 Kinematics and Dynamics of Machinery - Robert L. Norton, Tata McGraw-Hill, 2009.
4 Theory of Machines - Khurmi R.S and Gupta J.K. 14th Revised Edition, S. Chand and Company Ltd., New Delhi, 2005.
5 Theory of Machines - Ballaney P.L., 3rd Edition, Khanna Publishers, New Delhi, 2004.

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U17INI5600 **ENGINEERING CLINIC - III**

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. U17INI4600 - Engineering Clinic – II

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	S	S	S	S			S	S	S
CO2								S	S	S	S		M	M
CO3								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Workbook report	
3. Demonstration & Viva-voce	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fifth semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II.

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP5505 **SOCIAL VALUES** (Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the transformation from self to society
CO 2: Acquire knowledge about disparity among Human Beings
CO 3: Realize the new ethics in creating a more sustainable Society
CO 4: Develop skills to manage challenges in social issues
CO 5: Acquire the skills for Management of Social work & Holistic Society
CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						S						
CO2							S					
CO3								M				
CO4											S	
CO5												S
CO6									M			

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Self and Society: Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society

2. Social Values: Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace-nonviolence - right conduct- Unity – forgive – dedication – Honest

3. Social issues : Disparity among Human beings- Poverty-Sanitation -corruption- un employment-superstition – religious intolerance & castes – terrorism.

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4. Emerging Ethics for Sustainable Society: Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society

5. Social Welfare: Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of Holistic Society

Workshop mode

REFERENCES

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF
   discuss.forumias.com/uploads/File
   upload/.../711b18f321d406be9c79980b179932.pd...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...
   www.un.org/en/events/culturaldiversityday/pdf/Investing_in_cultural_diversity.pdf

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut
   www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E- class
   www.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU
   www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf

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SEMESTER 6

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U17AUI6201 **AUTOMOTIVE EMBEDDED SYSTEMS**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:

To give insight on the concepts of automotive embedded systems and to impart skills in developing models.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Select suitable sensors for measuring parameters in automotive systems
CO2: Choose the appropriate actuator and driver for automotive applications
CO3: Outline the concepts of embedded systems
CO4: Design of hardware model for automotive system using microcontroller
CO5: Build codes for automotive embedded applications
CO6: Compare the wired and wireless communication protocols

Pre-requisite:

1 U17AUT5201 - Automotive Electrical and Electronics Engineering

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S				S		S					S		S
CO2:	S				S							M		S
CO3:	M				S									S
CO4:		S	S		S								M	S
CO5:		S	S		S				M				M	S
CO6:					S							M		S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Quiz		
3	Continuous Assessment Tests		
4	End-Semester Examination		

SENSORS **L: 9 Hrs**

Introduction to automotive sensors ,Proximity sensors- inductive, capacitive, magnetic, Photoelectric, Ultrasonic sensors, Thermistor, Thermocouple, Hall effect sensor, Load cell, Optical rain sensor, Liquid level sensor, Lambda sensor, NOX sensor, MAP and MAF, Knock sensor, Angle sensor, Vibration sensor, Acceleration sensor, Pressure sensor, RPM sensor, Torque sensors, Position sensor.

ACTUATORS **L: 9 Hrs**

Solenoid –Types , Solenoid Switching, Relays and Optoisolators – Electromechanical relay, driving a relay, solid-state relay, Reed switch , Optoisolator, Operation and application of BLDC motors, Servo and stepper motors, Piezoelectric Actuators, Actuator Driver - H Bridge driver, Door actuator driver, Stepper motor driver, Transistor driver, Signal conditioner - Amplifier, Filter, Data Acquisition.

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EMBEDDED SYSTEM **L: 9 Hrs**

Introduction, Embedded system design process, Microcontroller v/s microprocessor, Architecture of 8/32 Bit controller - ADC, DAC, Memory, Timer and interrupts. Software development in IDE - Hardware/ Software configuration, Models of programs - Assembly, linking and loading. Structure of the Program - variables, functions, loops and I/O parameters.

INTERFACING WITH MICROCONTROLLER **L: 9 Hrs**

Sensor Interfacing: Analog and digital sensor, keyboard interface with 8/32 bit controller.

Actuator Interfacing: Motor control applications - Pulse width modulation (PWM), LCD display, relay and solenoid Interfacing with 8/32 bit controller. Serial communication interfacing.

COMMUNICATION PROTOCOLS **L: 9 Hrs**

Introduction to Communication protocol in embedded systems, Wired communication protocols – SPI, I2C and USB, CAN. Wireless communication protocols - Bluetooth HC05, Wi-Fi, RF transmitter and receiver, Internet of Things (IoT).

Practical

List of Exercises : **P: 30 Hrs**

1. Study of 8/32 Bit Microcontroller Architecture
2. LED Blinking using PWM
3. Interfacing Analog sensor
4. Interfacing Digital sensors
5. Interfacing DC Motor speed control with PWM
6. Interfacing Relay and solenoid Control application
7. Interfacing LCD
8. Interrupts and Timers
9. Study of CAN communication Network
10. Interfacing Serial communication

Theory : 45 Hrs	Practical: 30 Hrs	**Total Hours: 75**

References:

1. Electronic control unit (ECU). In: Reif K. (eds) Gasoline Engine Management. Bosch Professional Automotive Information by Kaiser M. (2015)
2. Sensors and Transducers - Ronald K. Jurgen, —, 2nd Edition, SAE, 2003
3. Automotive Sensors, BOSCH. 2002
4. Automotive Electronics Design Fundamentals 1st ed. 2015 Edition by Najamuz Zaman
5. Comprehensible Guide to Controller Area Network Paperback – 1 Aug 2005 by Wilfried Voss

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U17AUI6202 **VEHICLE DYNAMICS**

L	T	P	J	C
3	0	2	0	**4**

Course Objective:

To make the students familiarize over the forces and moments that generated in a vehicle and its influence over performance in acceleration and braking, handling qualities and ride qualities.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Identify the forces acting on vehicle for the given conditions and draw free body diagram
CO2: Infer and explain the phenomena of the forces that acts on the vehicle
CO3: Determine the reaction forces induced in the vehicle
CO4: Develop mathematical model of the vehicle system and elements
CO5: Provide solution by developing model and solving it
CO6: Justify the vehicle response for the forces and moments that acts on the vehicle

Pre-requisite:

1 U17AUT5104- Mechanics of Machines

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S			S				M	M				
CO2:	S	S		M	S				M	M		M	M	
CO3:	S	S			S							S		
CO4:	S	S	M	S	S							M	S	
CO5:	S	M	M	S	S							S	S	
CO6:	S	S	M	S	S				M	M		S	M	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

LONGITUDINAL DYNAMICS **L: 9 Hrs**

Introduction: Earth and vehicle coordinate system, Forces and Moments. Vehicle Load Distribution – position of CG - gradability- Acceleration - Free body diagram of accelerating vehicle, maximum transferable tractive force- tractive effort and reactions for different drive, Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance, maximum braking force, Vehicle performance .

TIRE MECHANICS **L: 9 Hrs**

Tire mechanics: Introduction -Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Pressure Distribution. Lateral Force Generation - cornering properties - Tire Models – Magic Formula - Classification of Tire Models.

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RIDE DYNAMICS **L: 9 Hrs**

Vibration – introduction, types, terminologies, source of vibration, human response, Degrees of freedom-single, two and multi degrees of freedom system, free, forced and damped vibration, magnification factor, transmissibility, vibration absorbers, pitch and bounce motion, oscillation centers, Suspension- types, active and semi active suspension, sprung mass and un-sprung mass, calculation of effective spring rate.

LATERAL DYNAMICS **L: 9 Hrs**

Vehicle control-low speed cornering and static steering – Ackerman steering geometry, steady-state cornering- steering factors, vehicle control parameters (understeer, 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 and constant radius testing and fish hook measurement testing.

VEHICLE STABILITY AND NOISE **L: 9 Hrs**

Stability of a vehicle – on slope, on curve and banked road

Noise- Introduction, properties of sound, sound level designation and measurement techniques- sound isolation and absorption- silencer and mufflers.

Practical

List of Exercises : **P: 30 Hrs**

1. Simulation of a telescopic suspension system
2. Simulation of a Rack and Pinion Steering system
3. Simulation of Mc Phearson strut suspension system
4. Simulation of braking characteristics of a four wheeler passenger car
5. Simulation of Cornering characteristics of a four wheeler passenger car.
6. Simulation test for roll stability of a four wheeler passenger car.
7. Driving Simulation of a passenger car in ISO Lane change and 3D road

Theory : 45 Hrs	Practical: 30 Hrs	**Total Hours: 75**

References:

1. Fundamentals of vehicle dynamics, Gillespie T D , SAE USA ,1992
2. Automotive Mechanics, Giri N K, Khanna Publisher, 2007
3. Ground vehicle Dynamics, Karl Popp and Werner O Schiehlen, Springer. 2012.
4. Road Vehicle dynamics – Theory and Application ,Masato Abe, Elsevier ,2009
5. Motor Vehicle dynamics- Modeling and Simulation, Giancarlo Genta, World Scientific,2006
6. Vehicle dynamics- Theory and Application, Reza N Jazzar, Springer,2008
7. Elementary Vehicle Dynamics, Cole D E , Ann Arbor, Michigan, USA,1972.
8. Theory of Ground Vehicles, Wong J Y, John Wiley and Sons, 1978
9. Martin Meywerk , Vehicle Dynamics- Automotive Series,Wiley,2015
10. Dr.R Krishnakumar,Vehicle Dynamics, NPTEL course https://nptel.ac.in/courses/107106080/

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U17AUT6003 **HYBRID AND ELECTRIC VEHICLES**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

This course will introduce general aspects of Hybrid and Electric Vehicle (HEV) technologies, including architectures, modeling, sizing, sub-system design and vehicle control. It will cover energy storage sources, electric propulsion systems, power electronics design, and HEV control.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Describe the configuration of hybrid and electric vehicles.
CO2: Identify the basic components of hybrid and elective vehicles.
CO3: Assess the characteristics and performance of the electric vehicle
CO4: Select suitable electric propulsion and control systems for HEV.
CO5: Choose proper energy storage systems for vehicle applications
CO6: Describe the operation of fuel cell and solar cell vehicles.

Pre-requisite:

1 U17AUT5201- Automotive Electrical and Electronics Engineering

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M	M				S		M	S		M		M
CO2:	S	S	M	M			S		S	S		S		S
CO3:	S	S	M	M			S	S	S	M				S
CO4:	S	S	S	M			S	S	S	M				S
CO5:	S	S	M	M			S	S	S	M				S
CO6:	S	M	M				S		M	S		M		M

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

ELECTRIC PROPULSION SYSTEMS **L: 8 Hrs**

Drive systems for EV & HEV, DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives, drive system efficiency - Control System principles, Speed and Torque control, Power electronic converters for HEV, Regenerative Braking.

ENERGY STORAGE SYSTEMS **L: 8 Hrs**

Requirements in Hybrid and Electric Vehicles, Types of batteries – lead acid batteries, nickel based batteries, and lithium based batteries - Battery Charging, Battery Characterization - capacity, discharge rate, state of charge, state of discharge, depth of Discharge, Technical characteristics, battery pack design, battery management system, Ultra capacitors.

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ELECTRIC VEHICLES **L: 7 Hrs**

History of electric vehicles, social importance of electric mobility, performance of e-vehicles - tractive effort and transmission requirements, vehicle performance, energy consumption, Specifications - System Components, Electric drive-trains topologies, power flow control in electric drive-train, fuel efficiency analysis.

HYBRID VEHICLES **L: 7 Hrs**

History of hybrid vehicles, social and environmental importance of hybrid vehicles, impact of modern drive-train on energy supplies. Hybrid Electric Drive-train configurations - basic concept of hybrid traction, architecture - merits and challenges, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

HEV PERFORMANCE **L: 8 Hrs**

Maximum speed - Acceleration – Gradeability, HEV - mechanics, efficiency, driving cycles, regulations, sizing the propulsion motor and power electronics, Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV), Vehicle Simulation, Comparison of ICEV and HEV, Well-to-Wheel Analysis.

FUEL CELL AND SOLAR VEHICLES **L: 7 Hrs**

Operations and Properties of Fuel cells – Phosphoric Acid Fuel cell, Proton Exchange membrane Fuel cell, Direct Methanol fuel cell Alkaline Fuel Cells, Solid Oxide Fuel Cell, Molten Carbonate Fuel Cell – Characteristics, electrochemical energy conversion – factors affecting electrochemical energy conversion - Solar Vehicles - photovoltaic cells, tracking, efficiency and cost comparison.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1. "Electric and Hybrid – Electric Vehicles" - Ronald K Jurgen,, SAE International, 2011.
2. "Electric and Hybrid Vehicles- Design Fundamentals" - Iqbal Husain, CRC Press, 2011.
3. "Electric Vehicle Technology Explained" - James Larminie, John Lowry, Wiley, 2012.
4. "Electric Vehicle Battery Systems" - Sandeep Dhameja, Butterworth – Heinemann, 2002.
5. "Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design" - Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, CRC Press, 2018.
6. "Fuel Cells Principles and Applications" - Viswanathan, B. and Aulice Scibioh, M., Universities Press (India) Pvt. Ltd., Hyderabad, 2006.
7. "Light Weight Electric Hybrid Vehicle Design" - Ron Hodkinson and John Fenton, Butterworth – Heinemann, 2009.
8. "Vehicular Electric Power Systems" - Ali Emadi, Mehrdad Ehsani, John M. Muller, , Marcel Dekker,Inc., 2004.
9. "Recent Trends in Fuel cell Science and Technology" - Basu .S, Anamaya Publishers, New Delhi.,2007.
10. "Fuel Cell Technology Handbook", Gregor Hoogers, CRC Press, 2003.

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U17AUT6004

TOTAL QUALITY MANAGEMENT AND PROJECT MANAGEMENT

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

Expose the students to learn how to apply the Total Quality Management Techniques for an industry in turn for the product & To develop their ability in planning and execution of a project effectively.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Relate quality concepts and philosophies of TQM
CO2: Apply TQM tools as a means to improve quality
CO3: Select the lean six sigma tools for improving the productivity
CO4: Categorize the structure of the organization
CO5: Identify competency in project planning, scheduling and related activities
CO6: Develop network models and analyze the cost accounting

Pre-requisite:

1 NIL

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M	M							S	S	S	S		
CO2:	M	M			S				S	S	S	S		
CO3:	M	M			S				S	S	S	S		
CO4:		M							S	S	S	S		
CO5:	M	M							S	S	S	S		
CO6:		M			S				S	S	S	S		

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests	2	
3	End-Semester Examination	3	

TQM PRINCIPLES **L: 9 Hrs**

Definition of Quality, Dimensions of Quality, Quality Costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time.

TQM TOOLS & STATISTICAL TOOLS **L: 9 Hrs**

The seven tools of quality, New seven Management tools, Statistical Fundamentals .Concept of six sigma. Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function.

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QUALITY SYSTEMS **L: 9 Hrs**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

PROJECT ORGANIZATION AND MANAGEMENT **L: 9 Hrs**

Introduction, project characteristics, taxonomy of projects, project identification and formulation. Organizing human resources, organizing systems & procedures for implementation. Project direction. selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

PLANNING ,SCHEDULING , NETWORK MODELS, PROJECT APPRAISAL **L: 9 Hrs**

PERT & CPM Cost accounting systems, lowest Cost schedule, crashing of networks, linear programming formulation of event oriented networks, updating of networks, LOB technique. computer aided project management- essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections. Cost analysis of the project, components of capital Cost of a project, modern approach to project performance analysis.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education 2011
2 Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
3 D.R. Kiran Total Quality Management: Key Concepts and Case Studies Butterworth-Heinemann, 2016
4 Nagarajan. K, "Project "Management, New Age International, 2012.
5 Harvey Maylor, "Project Management", Prentice Hall, 2010.
6 Erik W. Larson, "Project Management": The Managerial Process (Special Indian Edition), Tata McGraw-Hill Education, 2006
7 Joseph Phillips,PMP Project Management Professional Study Guide, Fourth Edition,McGraw Hill Professional, 2013

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U17INI6600 **ENGINEERING CLINIC - IV**

L	T	P	J	C
0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:

1. U17INI5600 - Engineering Clinic - III

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S	S	S	S	S	S	S	S			S	S	S
CO2								S	S	S	S		M	M
CO3								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Workbook report	
3. Demonstration & Viva-voce	

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fourth semester, students will focus primarily on Reverse engineering project to improve performance of a product.

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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP6506 **NATIONAL VALUES** (Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Acquire knowledge on the Essence of Indian Knowledge Tradition

CO 2: Know the great Indian personalities and follow their trail

CO 3: Understand the specialty of democracy

CO 4: Disseminate our Nation and its values to propagate peace

CO 5: Contribute with their energy and effort for a prosperous India

CO 6: Propagate the youth and the contribution for development of our Nation

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						S						
CO2									M			
CO3							M					
CO4								S				
CO5											S	
CO6												M

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Essence of Indian Knowledge Tradition:

Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition - Indian Linguistic Tradition - Indian Artistic Tradition.

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2. Great Indian Leaders : Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates -Scientists – Statesman.
3. Largest Democracy : Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.
4. India's Contribution to World peace : Nonaligned Nation – Principle of Pancha Sheela – Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.
5. Emerging India : World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

Workshop mode

REFERENCES

1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, *CBSE Publication* ___*cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_6_2.pdf*

2. CULTURAL HERITAGE OF INDIA - SCERT Kerala www.scert.kerala.gov.in/images/2014/HSC.../35_Gandhian_Studies_unit-01.pdf

3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO www.unesdoc.unesco.org/images/0014/001480/148021e.pdf

4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick www2.warwick.ac.uk/fac/arts/history/students/modules/hi297/.../week1.pdf

5. INDIA'S CONTRIBUTION TO THE REST OF THE WORLD - YouSigma www.yousigma.com/interesting facts/indiasgifttotheworld.pdf

6. INDIA AS AN EMERGING POWER - International Studies Association web.isanet.org/Web/Conferences/.../11353cac-9e9b-434f-a25b-a2b51dc4af78.pdf

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SEMESTER 7

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U17AUI7201

VEHICLE MAINTENANCE AND RECONDITIONING

L	T	P	J	C
2	0	2	0	**3**

Course Objective:

Impart knowledge and skill on Vehicle Maintenance and Troubleshooting of automotive systems.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Familiarise the need and procedures of service records used for vehicle maintenance
CO2: Examine and troubleshoot engine malfunctions
CO3: Identify the conditions of battery and auxiliary electrical systems.
CO4: Describe the repair procedure for vehicle chassis and body components
CO5: Asses and rectify the wheel and tire parameters
CO6: Inspect and troubleshoot the HVAC system

Pre-requisite:

1 U17AUI3201- Automotive Chassis and Transmission

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:			S		M	S			M			M		S
CO2:	M			M		S					S			S
CO3:			S		M	S	M							S
CO4:	S	M	M		S	S	M							S
CO5:		S			M	S								S
CO6:			S		M	S	M							S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

LAYOUT OF AUTOMOTIVE SERVICE STATION - RECORDS AND PROCEDURES **L: 8 Hrs**

Introduction to vehicle maintenance, Importance and need for maintenance, preventive and breakdown maintenance. Tools and Instruments used in Maintenance shop, Layout of Automotive Repair, Service & Maintenance Shop.

Preparation of check lists, safety. Inspection schedule, maintenance of records, log sheets Trip sheet and Road test report. Service schedule and service history maintenance, Workshop Management, spare parts warranty.

REPAIR AND MAINTENANCE OF ENGINE AND CHASSIS SYSTEM **L: 8 Hrs**

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.- Need for overhauling- Preparation of Cost sheets (estimation)- Engine performance analysis-Troubleshoot and Remedies Mechanical and automobile clutch and gear box, servicing and maintenance, maintenance servicing of propeller shaft

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and differential system. Servicing of suspension systems, steering systems, overhauling and maintenance. On Road Vehicle Handling and Testing.

MAINTENANCE OF ELECTRICAL SYSTEM **L: 6 Hrs**

Testing methods for checking electrical components, checking- battery, starter motor, charging systems, DC generator and alternator, ignitions system, lighting systems. Fault diagnosis and maintenance of electronic systems, checking and servicing of instrument cluster.

REPAIR AND MAINTENANCE OF FUEL SYSTEM, COOLING SYSTEMS, LUBRICATION SYSTEM AND VEHICLE BODY **L: 8 Hrs**

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. Manufacture recommended fluids- Kaizen method on schedule services, how to increase productivity and efficiency- Case studies. Field surveys. - Latest technologies in servicing

Practical

List of Exercises : **P: 30 Hrs**

1 Lighting System Trouble shooting & Servicing.
2 Fault diagnosis of Air-Conditioning system.
3 Tire maintenance and wheel balancing.
4 Measurement of camber, caster, kingpin inclination and alignment of toe-in and toe-out
5 Braking System Troubleshooting & Servicing
6 Diagnosis of Engine ECU
7 Performance Testing of Two-Wheeler using 2-Wheeler Chassis Dynamometer
8 Experimental Study about Gearbox, Steering, Suspension system Maintenance
9 On-road Braking, Acceleration and Fuel economy test

Theory : 30 Hrs	Practical: 30 Hrs	**Total Hours: 60**

References:

1 John Doke, "Fleet management ", McGraw Hill Co, 1984.
2 James D Halderman - Advanced Engine Performance Diagnosis PHI - 1998.
3 Judge A N, “Motor vehicle engine servicing, 3rd, Edition ", Pitman Paper pack, London, 1969.
4 Automotive Trouble shooting and Maintenance by Anderson Ashburn
5 Venk. Spicer, Automotive Maintenance and Trouble shooting.
6 Service Manuals from Different Vehicle Manufacturers
7 Vehicle Maintenance and Garage Practices -Dhruv U. Panchal, Jigar A. Doshi, PHI learning Pvt, Ltd.

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U17AUT7002 **AUTOMOTIVE EMISSIONS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

Impart knowledge on the wastes produced from automobiles and the emission formation mechanisms.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Outline the impact of pollutants on global environment and its climatic change
CO2: Examine the emission formation mechanisms and techniques to minimize emissions formation in I.C. engines.
CO3: Describe automotive emission control technologies.
CO4: Familiarise about emission standard, measurement, test procedure and regulations
CO5: Identify the wastes produced from automobiles.
CO6: Explain the available disposal methods of waste.

Pre-requisite:

1 U17AUI4201- Automotive Engines and Systems

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S		S			S	S		M				S	
CO2:	S		S			S	S		M				S	
CO3:	S		S			S	S		M				S	
CO4:	S		S			S	S	S	M				S	
CO5:			M			S	S	M	M				S	
CO6:	S		S			S	S	S	M				S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

POLLUTANT FORMATION EFFECT ON ENVIRONMENT **L: 7 Hrs**

Pollutants – sources – formation – effects of pollution on environment - human – transient operational effects on pollution – Regulated –- Emission Standards-Euro, Bharat Stage & Legislative Norms.

EMISSION FORMATION IN S.I ENGINES **L: 7 Hrs**

Pollution formation in SI Engines – HC and CO formation in SI engines – NO formation in SI engines – Smoke emissions from SI engines – Effect of operating and design variables on emission formation.

EMISSION FORMATION IN CI ENGINES **L: 7 Hrs**

Pollutant Formation In CI Engines – Smoke emission and its types in diesel engines – NOx emission and its types from diesel engines-– Particulate emission in diesel engines- Effect of operating and design variables on emission formation.

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EMISSION CONTROL AND MEASUREMENT TECHNIQUES **L: 12 Hrs**

Design Of Engine, Optimum Selection Of Operating Variables For Control Of Emissions- EGR, SCR, Lean DeNOx catalyst-Thermal Reactors, Secondary Air Injection, Water Injection.- After Treatment: Catalytic Converters, Catalysts, CO_2 Emission Reduction- Diesel Particulate Filter- Fuel Modifications. Emission Standards, Driving Cycles - USA, Japan, Euro And India.– NDIR analyzer – Flame ionization detectors – Chemiluminescent analyzer – Dilution tunnel – Gas chromatograph – Smoke meters –SHED test.

AUTOMOTIVE WASTES **L: 6 Hrs**

Introduction-Types of Automobile waste-Electrical waste, Battery waste, Copper elements-Electronic circuit wastes-Tyre wastes-Mechanical wastes, Body panel, Chassis components.

WASTE DISPOSAL AND MANAGEMENT TECHNIQUES **L: 6 Hrs**

Battery disposal procedure, management of battery waste, Steps involved in recycling batteries, Hydrometallurgical process, Hydrometallurgical process, Mercury distillation-Tyre disposal techniques.

Theory : 30 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 IC Engines Combustion and Emissions, B.P.Pundir, Narosa Publishers, 2010
2 Internal Combustion Engines,Ganesan, V- Tata McGraw-Hill Co.- 2017
3 Robert Bosch, "Emissions-Control Technology for Diesel Engines", BENTLEY ROBERT Incorporated, 2005.
4 Automobiles and Pollution, Paul Degobert– SAE International ISBN-156091-563-3, 1991.
5 *Internal Combustion Engines and Air Pollution* Edward F, Obert,*"*, Intext Education Publishers, 1980.
6 Mathur and Sharma, "*A course on Internal combustion Engines*", Dhanpat Rai & Sons, 1985.

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U17AUP7703 **PROJECT WORK - PHASE – I**

L	T	P	J	C
0	0	0	6	**3**

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify practical problems and find a solution related to automotive and relative domains

CO2: Understand the project management practices

CO3: Demonstrate their report writing and presentation skills

Pre-requisite:

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CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S	S	S	S	S	S	S			S	S	S
CO2:								S	S	S	S		M	M
CO3:								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Project report	
3. Viva Voce	

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 and allied areas.
2. The project work include literature review, modeling, analysis, simulation, fabrication, testing and analysis & correlation of test data etc.
3. Can be individual or a group project, with maximum of 3 students per group.
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 to be submitted at the end of the semester in the required format.
7. The review presentations and project report should contain the individual work allocation & contribution, estimated & actual time schedule with charts (PERT/GANTT), literature survey, drawings in addition to the details of project work carried out.

Total Hours 90

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U17VEP7507 **GLOBAL VALUES**
(Mandatory)

L	T	P	J	C
0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to:

CO 1: Aware of the concept of Universal Brotherhood and support the organizations which are working for it

CO 2: Follow the path of Ahimsa in every aspect of their life

CO 3: Uphold the Universal declaration of Human Rights

CO 4: Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth

CO 5: Sensitize the environmental degradation and work for the sustainable development

CO 6: Amalgamate harmony through Non-violence and edify the nation headed for upholding development

Pre-requisites :

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES
6. U17VEP6506 / NATIONAL VALUES

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M					
CO2								S				
CO3									M			
CO4						S						
CO5											M	
CO6												S

Course Assessment methods

Direct
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test
Indirect
1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. Universal Brotherhood : Meaning of Universal Brotherhood- Functioning of Various organization for Universal human beings -Red Cross, UN Office for Humanitarian Affairs – Case study on humanitarian problems and intervention - Active role of Students/Individual on Universal Brotherhood.

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2. Global Peace, Harmony and Unity : Functions of UNO - Principal Organizations - Special organization – Case study relating to disturbance of world peace and role of UNO – Participatory role of Students/Individual in attaining the Global peace and Unity.
3. Non-Violence : Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence– Practicing nonviolence in everyday life.
4. Humanity and Justice: Universal declaration of Human Rights - Broad classification - Relevant Constitutional Provisions– Judicial activism on human rights violation - Case study on Human rights violation– Adherence to human rights by Students/Individuals.
5. Inclusive growth and sustainable development : Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality – Protection of environment – Case study on inequality and environmental degradation and remedial measures.

Workshop mode

REFERENCES

1. TEACHING ASIA-PACIFIC CORE VALUES OF PEACE AND HARMONY – UNICEF www.unicef.org/.../pdf/Teaching%20Asia-Pacific%20core%20values.pdf

2. THREE-DIMENSIONAL ACTION FOR WORLD PROSPERITY AND PEACE-IIM Indore - www.iimidr.ac.in/.../Three-Dimensional-Action-for-World-Prosperity-and-Peace-Glo...

3. MY NON-VIOLENCE - MAHATMA GANDHI www.mkgandhi.org/ebks/my_nonviolence.pdf

4. HUMAN RIGHTS AND THE CONSTITUTION OF INDIA 8th ... - India Juris www.indiajuris.com/uploads/.../pdf/l1410776927qHuman%20Rights%20080914.pdf

5. THE ETHICS OF SUSTAINABILITY – Research Gate www.researchgate.net/file.PostFileLoader.html?id...assetKey..

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SEMESTER 8

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U17AUP8701 **PROJECT WORK - PHASE – II**

L	T	P	J	C
0	0	0	24	**12**

Course Outcomes

After successful completion of this course, the students should be able to:

CO1: Identify and solve practical problems and find a solution related to automotive and relative domains

CO2: Understand the project management techniques

CO3: Demonstrate their report writing and presentation skills

Pre-requisite:

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CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S	S	S	S	S	S	S			S	S	S
CO2:								S	S	S	S		M	M
CO3:								S		S				

Course Assessment methods:

Direct	Indirect
1. Project reviews	1. Course Exit Survey
2. Project report	
3. Viva Voce	

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 for the most appropriate problems.
4. A project report is required to be submitted at the end of the semester in the required format.
5. The review presentations and project report should contain the individual work execution & contribution, actual time schedule with charts (PERT/GANTT), literature survey, drawings, analysis report, DFMEA/FMEA charts in addition to the details of project work carried out.
6. Project work done at Industry should be duly supported by certificate from the Industry.
7. The progress of the project is evaluated based on a minimum of three reviews and end semester viva-voce examination.

Total Hours 360

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PROFESSIONAL ELECTIVE

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AUTOMOTIVE DESIGN

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U17AUE0001 **DESIGN OF ENGINE COMPONENTS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
The course provides basic knowledge on designing of IC engine components.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the design procedure for piston and cylinder
CO2: Apply the design assumption in validating the types of connecting rod used in IC engines.
CO3: Calculate the parameters required for designing the crankshaft
CO4: Understand the steps involved in designing of different types of automotive clutch
CO5: Apply the assumption and design valves and valve train
CO6: Explain design methods for engine components

Pre-requisite:
1 U17AUI3202 - Strength of Materials
2 U17AUI4201 - Automotive Engines and Systems
3 U17AUT5103 – Design of Machine Elements

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M	M	W						W	W			S	
CO2:	S	S	M						M	M			M	M
CO3:	S	S	M					W					S	
CO4:	S	S	M					W					S	
CO5:	S	S	M										S	
CO6:	S	S	M										S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

DESIGN OF CYLINDER AND PISTON **L: 9 Hrs**
Choice of material for cylinder and piston, design assumptions and procedure for cylinder and piston. Design of cylinder, piston, piston pin, piston rings.

DESIGN OF CONNECTING ROD **L: 9 Hrs**
Design of Connecting Rod-determining minimum length of connecting rod, small end design, Big end design, shank design, design of cap bolts.

DESIGN OF CRANKSHAFT **L: 9 Hrs**
Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.

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DESIGN OF CLUTCH **L: 9 Hrs**

Design of single plate clutch, multiplate clutch, design of centrifugal clutch, and cone clutch, energy dissipated, torque capacity of clutch, design of Clutch Components.

DESIGN OF VALVES AND VALVE TRAIN **L: 9 Hrs**

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

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Engine Design – Giles J. G., Lliffe Book Ltd.1968
2 Engine Design – Crouse, Tata McGraw Publication, Delhi
3 Khurmi. R.S. & Gupta. J.K., A textbook of Machine Design, Eurasia Publishing House (Pvt) Ltd, 2001.
4 Vehicular Engine Design – Hoag, Kevin, Springer
5 Internal Combustion Engine Design – John Manning, Ricardo UK Ltd
6 Giri.N.K, Automobile Mechanics, Khanna Publishers, New Delhi, 2007.

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U17AUE0002 **DESIGN OF CHASSIS COMPONENTS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Build knowledge on design of Automotive Chassis components.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Calculate loads, moments and stresses on frame members and suspensions.
CO2: Design front axle and examine the steering components
CO3: Explain the design concepts of final drive and rear axle
CO4: Determine parameters involved in gear box design.
CO5: Solve problems related to Automotive braking System
CO6: Improve the overall design of chassis.

Pre-requisite:
1 U17AUI3201- Automotive Chassis and Transmission
2 U17AUI3202 - Strength of Materials

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	**S**	**S**	M	M									**S**	
CO2:	**S**	**S**	S	M									**S**	
CO3:	**S**	**S**	M	S									**S**	
CO4:	**S**	**S**	M	S									**S**	
CO5:	**S**	**S**	M	M									**S**	
CO6:	**S**	**S**	S	S									**S**	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

VEHICLE FRAME AND SUSPENSION **L: 9 Hrs**
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.

FRONT AXLE AND STEERING SYSTEMS **L: 9 Hrs**
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 Dimension and Proportions for Steering Linkages ensuring minimum error in Steering.

DRIVE LINE AND REAR AXLE **L: 9 Hrs**
Design of propeller shaft. Design details of final drive gearing. Design details of full floating, semi-floating and three quarter floating rear shafts and rear axle housings and design aspects of final drive.

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GEAR BOX **L: 9 Hrs**

Gear train calculations, layout of gearboxes. Design of gearboxes.

BRAKING SYSTEM **L: 9 Hrs**

Function, stopping time and distance, weight transfer during braking, brake actuating mechanisms – mechanical, hydraulic and pneumatic, disc and drum brakes - design of brake shoes and friction pads.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "Automobile Chassis Design Book", Dean Averns, 2nd edition, Kotelian sky Press, 2009.
2 "Introduction to Modern Vehicle Design", Julian Happian-Smith, SAE International, 2004.
3 Automobile Mechanics, Giri, N.K., Khanna publishers, New Delhi, 2007.
4 Heldt, P.M., Automotive Chassis, Chilton Book Co., 1992.
5 Dean Averns, Automobile Chassis Design, Illife Book Co., 2001.

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U17AUE0003 **COMPUTATIONAL FLUID DYNAMICS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Impart knowledge on various CFD Techniques to solve simple fluid flow and heat transfer problems.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Introduce Governing Equations of viscous fluid flows
CO2: Discretize the governing equations by Finite Difference Method and Finite volume Method.
CO3: Solve basic convection and diffusion equations and understand its role in fluid flow and heat transfer problems..
CO4: Apply the solution algorithms to determine the flow field variables.
CO5: Understand turbulence equations in mathematical form and various types of grids used to solve the flow problem.
CO6: Create confidence to solve flow and heat transfer problems by using commercial software packages.

Pre-requisite:
1 U17AUI4202- Fluid Mechanics and Machinery

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M											M		
CO2:	S	S	S	M	M							M	M	
CO3:	S	S	S	M	M							M	M	
CO4:	S	S	S	M	M							M	M	
CO5:	S	S	S	M	M							M	M	
CO6:	S	S	S	M	M							M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

GOVERNING EQUATIONS AND BOUNDARY CONDITIONS **L: 8 Hrs**
Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION **L: 9 Hrs**
Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three –dimensional diffusion

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problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

FINITE VOLUME METHOD FOR CONVECTION DIFFUSION **L: 10 Hrs**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

FLOW FIELD ANALYSIS **L: 9 Hrs**

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

TURBULENCE MODELS AND MESH GENERATION **L: 6 Hrs**

Turbulence models, mixing length model, Two equation (k-ε) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh.

PRACTICAL ASPECT OF CFD **L: 3 Hrs**

Grid generation – Structured and unstructured mesh, Case study using commercial CFD software

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "An Introduction to Computational Fluid Dynamics: The finite volume Method", Versteeg H.K., and Malalasekera W., Pearson Education Ltd., 2nd Edition, 2007.

2 "Numerical Heat Transfer and Fluid Flow", Patankar, S.V., Hemisphere Publishing Corporation (CRC Press), 1st Edition, 1980.

3 "Computer Simulation of flow and heat transfer", Ghoshdastidar, P.S., Tata McGraw Hill Publishing Company Ltd., 1998.

4 "Computational Fluid Dynamics", Chung, T.J., Cambridge University, Press, 2nd Edition, 2010.

5 "Computational Fluid Flow and Heat Transfer", Muralidhar, K., and Sundararajan, T., Alpha Science International Ltd., 2nd Revised edition edition, 2003.

6 "Introduction to Computational Fluid Dynamics", Prodip Niyogi, Chakrabarty, S.K., Laha, M.K., Pearson Education, 1st Edition, 2005.

7 https://confluence.cornell.edu/display/SIMULATION/FLUENT+Learning+Modules

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U17AUE0004

COMPUTER SIMULATION OF IC ENGINE PROCESSES

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
To Impart Knowledge In Simulating IC Engine Processes.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Understand the significance of various processes in I.C Engines.
CO2: Learn the simulation of engine combustion based on first and second law of thermodynamics.
CO3: Calculate minimum air required for combustion of I.C Engines.
CO4: Write combustion equation for hydrocarbon fuels.
CO5: Apply the simulation techniques for modification of combustion chamber
CO6: Apply the simulation techniques to develop new engine concept

Pre-requisite:
1 U17AUI4201 - Automotive Engines and Systems

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S													
CO2:	S													
CO3:	S	S												
CO4:	S	M												
CO5:	S	S	S	S								M	S	
CO6:	S	S	S	S								M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION **L: 9 Hrs**

Introduction to Simulation, Advantages of computer simulation, Classification of engine models. Intake and exhaust flow models – Quasi steady flow - Filling and emptying - Gas dynamic Models. Thermodynamic based in cylinder models. Step by step approach in SI & CI engine simulation.

COMBUSTION AND STOICHIOMETERY **L: 9 Hrs**

Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air required for combustion, excess air supplied and stoichiometric air required for complete combustion. Conversion of volumetric analysis to mass analysis.

ADIABATIC FLAME TEMPERATURE **L: 9 Hrs**

Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state. SI Engine simulation with air as working medium, deviation between actual and ideal cycle

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SIMULATION OF IC ENGINES **L: 9 Hrs**

SI and CI engine simulation – Air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – Part throttle, full throttle and supercharged conditions

SIMULATION OF NEW ENGINE CONCEPT **L: 9 Hrs**

Dual fuel engine, low heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine and controlled auto ignition engine.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Ganesan,V., Computer Simulation of spark ignition engine process, Universities Press (I) Ltd., Hyderabad, 2013.

2 Ganesan V, "Computer Simulation of Compression-Ignition Engine Processes", University Press (I) Ltd, Hyderabad, 2013

3 Ramoss,A.L., Modelling of Internal Combustion Engines Processes, McGraw Hill Publishing Co., 1992.

4 Benson,R.S., Whitehouse,N.D., Internal Combustion Engines, Pergamon Press, Oxford, 1979.

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AUTOMOTIVE MANUFACTURING

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U17AUE0005

AUTOMOTIVE COMPONENTS MANUFACTURING

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

Impart knowledge on various processes involved in the manufacturing of automotive components.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Distinguish the various Manufacturing Processes employed in manufacturing Engine components
CO2: Choose the right Manufacturing Process for manufacturing Transmission system components
CO3: Select the relevant Heat and surface treatment methods for Engine and Transmission Components
CO4: Outline the Automotive Body Components Manufacturing methods
CO5: Identify the surface Coating Processes used in Automotive Industry
CO6: Suggest the suitable machining process for Automotive components manufacturing

Pre requisite:

1 U17AUI3203-Manufacturing Technology

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	M				M	M		S			M	S
CO2:	S	S	M				M	M		S			M	S
CO3:	S	S	M			M	M							S
CO4:	M	S	M			M	M	M		S				S
CO5:	S	M				S	S	S						S
CO6:	S	S	M							S				S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

ENGINE COMPONENTS **L: 10 Hrs**

Casting of Engine block - conventional and expendable pattern, Casting of cylinder heads,Cylinder liners, Crankshaft, Connecting rod and Gudgeon pins-forging and casting, machining and heat treatment.

Casting of Piston - gravity casting, squeeze casting, machining and finishing and piston ring manufacturing.

Upset forging of valves - heat treatment and surface improvement.

Engine bearing manufacturing.

TRANSMISSION COMPONENTS - I **L: 10 Hrs**

Manufacturing of friction plates using conventional blanking and fine blanking. Manufacture of composite friction lining, composite moulding of phenol formaldehyde lining.

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Casting of gear box casing,
Precision forging of gears, gear hobbing, shaping, powder metallurgy, orbital forming of spur, helical, and bevel gears, hypoid gears, heat treatment and finishing.

TRANSMISSION COMPONENTS-II **L: 10 Hrs**

Propeller shaft – Continuous Casting, extrusion, heat treatment and surface hardening, Composite propeller shaft manufacturing.
Forging of rear axles, casting of rear axle casing,
Manufacturing of wheels and brake drums.

BODY COMPONENTS **L: 10 Hrs**

Introduction- Thermoforming and Hydro forming, Press forming of body panels. Welding of body panels - resistance welding, Spot welding, Seam welding.
Injection moulding – Introduction, instrument panel, bumpers, Reinforced Reaction injection moulding.
Manufacture of metal and polymer panels.
Adhesives and sealants
Manufacturing of Springs , Wrap forming of coil springs,leaf springs, Composite leaf springs

SURFACE COATINGS **L: 5 Hrs**

Chemical Vapour deposition, Physical Vapour deposition, sol-gel processing
Spraying, Plating, Painting in paint booth.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Philip F. Ostwald & Jairo Munuz, “Manufacturing Processes and Systems”, John Wiley & Sons, New York, 1998.
2 Degarmo E.P., “Materials and process in Manufacturing”, Macmillan Publishing Co, 2012 .
3 Kalpakjian, “Manufacturing Engineering and Technology”, Publisher: Pearson, 2013
4 Sanjay K Mazumdar, “Composites Manufacturing”, CRC Press, NY, 2003.

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U17AUE0006

DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

To learn the design process /aspects and its effect on different manufacturing processes and to acquire knowledge for providing tolerance specification and representation used in assembly.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Outline the design aspects for selection of Materials, Manufacturing processes for economical production.
CO2: Identification of design processes for various machining and metal joining processes.
CO3: Apply a systematic understanding of design knowledge in the areas of metal casting and forging
CO4: Familiarise the knowledge of Geometric Dimensioning and Tolerances
CO5: Identify the details required for mechanical documentation.
CO6: Integrate the knowledge of compliance analysis and interference analysis for assembly.

Pre-requisite:

1 U17AUI3203 - Manufacturing Technology

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S	S				M		S		M	M	
CO2:	S	M	M	M					M	M			M	S
CO3:	M	M	M	M					M				M	S
CO4:	S	S	S	M					M	S			S	M
CO5:	M				M					M				M
CO6:	S	S	S	M						M			S	M

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY **L: 9 Hrs**

DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on Cost basis.

GEOMETRIC DIMENSIONING & TOLERANCE INTRODUCTION **L: 9 Hrs**

Process capability, process capability metrics, Cp, Cpk , Cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law, 6σ concept.

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TOLERANCE CHARTING TECHNIQUE **L: 9 Hrs**

Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

DESIGN FOR MANUFACTURE **L: 9 Hrs**

Design features to facilitate machining, datum features - Functional and manufacturing, component design-machining considerations, redesign for manufacture, examples Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols – Case studies.

SELECTIVE ASSEMBLY **L: 9 Hrs**

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1. Design for Manufacturability Handbook, James G. Bralla, Second Edition, McGraw-Hill companies, New York, USA. (1998)
2. Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst and Winston Knight Second Edition, CRC press, Taylor & Francis, Florida, USA (2002)
3. G. E. Dieter and L. C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
4. Design for Manufacturing and assembly, O. Molloy, S. Tilley and E.A. Warman , First Edition, Chapman &Hall, London, UK (1998).
5. "Design for Economic Production", Trucks H E, Society of Manufacturing Engineers, Michigan, 1987.
6. J. J. Shah, An Assessment of Features Technology, Proc. CAM-1 Features Symposium, Boston, MA, August 9-10, 1990, p. 55.
7. J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc.
8. I. Zeid, R. Siva Subramanian (2009) CAD/CAM Theory and Practice, 2nd edition Tata McGraw-Hill education private limited, New Delhi.
9. Port-compatibility and connectability based assembly design, P. Singh, B.Bettig, Journal of Computing and Information Science in Engineering, 4 (2004) pp.197-205.
10. Extended liaison as an interface between product and process model in assembly, A.K. Swain, D Sen, B. Gurumoorthy,Robotics and Computer-Integrated Manufacturing, 30 (5), pp.527-545.

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U17AUE0007

COMPOSITE MATERIALS AND STRUCTURES

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provide knowledge on properties, micromechanics, macro mechanics and also the manufacturing of Composite materials.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Outline the types, advantages and properties of Composite Materials
CO2: Apply the knowledge of micro mechanics to calculate the properties of a Lamina
CO3: Calculate the properties of a Laminate
CO4: Analyze the material properties and failure criteria of Composites
CO5: Explain the basic design concepts and materials used for sandwich construction
CO6: Summarize the methods used for fabrication of fiber

Pre-requisite:
1 Nil

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	W					W						M	S	
CO2:	S	S	M				W						S	
CO3:	S	S	S				W					M	S	
CO4:	S	S	S				W						S	
CO5:	M	W	W										S	
CO6:	M					W	W					M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

STRESS STRAIN RELATION **L: 8 Hrs**
Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalized Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

METHODS OF ANALYSIS **L: 10 Hrs**
Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties.

LAMINATED PLATES **L: 12 Hrs**
Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites.

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SANDWICH CONSTRUCTIONS **L: 8 Hrs**

Basic design concepts of sandwich construction -Materials used for sandwich construction - Failure modes of sandwich panels.

FABRICATION PROCESS **L: 7 Hrs**

Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998
2 Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
3 Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
4 Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989
5 https://nptel.ac.in/courses/101104010/
6 Autar K. Kaw., 'Mechanics of Composite Materials', Taylor & Francis-India; Second Edition edition (2006)

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U17AUE0008 **ADDITIVE MANUFACTURING AND TOOLING**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Expose the students with fundamental and advanced knowledge in the field of Additive manufacturing technology and its industrial applications.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Classify the concepts and terminologies of additive manufacturing
CO2: Apply the reverse engineering concepts for design development
CO3: Identify the variety of additive manufacturing techniques based on end product applications
CO4: Design and develop newer tooling models
CO5: Familiarise with cutting edge technologies in rapid tooling and manufacturing
CO6: Analyse the cases relevant to Additive manufacturing

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M				W	M					M		M
CO2:	S	S	S	M	W		S	M				M		S
CO3:	S	M					M							M
CO4:	S	S	S	M	W		S	M	M					S
CO5:	S	M			W		M					M		S
CO6:	S	S	S	M			M	M						S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION **L: 9 Hrs**
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits Applications.

REVERSE ENGINEERING & CAD MODELING **L: 9 Hrs**
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.


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ADDITIVE MANUFACTURING SYSTEMS **L: 9 Hrs**

Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

SINTERING BASED ADDITIVE MANUFACTURING SYSTEMS **L: 9 Hrs**

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies

TOOLING **L: 9 Hrs**

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "Rapid prototyping: Principles and applications", Chua, C.K., Leong K.F. and Lim C.S., second edition, World Scientific Publishers, 2010.
2 Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRC press, 2005.
3 "Rapid prototyping", Gebhardt, A., Hanser Gardener Publications, 2003.
4 Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
5 Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

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AUTOMOTIVE ELECTRICAL AND ELECTRONICS

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U17AUE0009 **AUTOMOTIVE CONTROL SYSTEM**

L	T	P	J	C
2	0	2	0	**3**

Course Objective:

To impart knowledge in the Model based system design. By the end of the course, it should enable the student

- To obtain the mathematical model of any system/sub system of a vehicle.
- To model and simulate automotive systems with the help of modern simulation tools

To design a suitable controller for any given application.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Identify the level of the system that is more suitable for model based system design
CO2: Select appropriate modelling technique according to the available inputs for automobiles.
CO3: Understand and apply the fundamental laws of physics and mathematics to obtain the mathematical model of any system / sub system of a vehicle.
CO4: Create a simulation model of a simple automotive system
CO5: Implement a suitable controller applicable for any automotive system.
CO6: Analyse the performance of the sub-system / system using software tools based on the test inputs given to the system.

Pre-requisite:

1 U17AUI6201- Automotive Embedded Systems

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	**S**		**S**											M
CO2:		**S**	**S**											
CO3:	S	M												S
CO4:				S	S				M	M	M			
CO5:			S	S	S				M	M	M			M
CO6:			S	S	S				M	M	M			S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

MODEL BASED SYSTEM DESIGN **L: 6 Hrs**

Introduction to model based design, Model based system design in Functional level, Architectural level, Implementation level, limitations on model based design, Process Design- requirements, mathematical modeling, validation and verification, In-loop testing - SIL, HIL

MODELING TECHNIQUES **L: 6 Hrs**

Introduction to Modeling - Graphical modeling, Signal flow modeling, State machines modeling, Transfer function modeling, State space modeling, Event based modeling, Statistical modeling for system identification

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MATHEMATICAL MODELING OF ELEMENTARY SYSTEMS **L: 6 Hrs**

System, Control system, Modeling – Lumped system dynamic behavior represented by ordinary differential equations –Modeling Translational and rotational mechanical Systems, Electrical systems, Electrical Analogous for Mechanical Systems, hydraulic systems and thermal systems

INTRODUCTION TO TIME AND FREQUENCY RESPONSE ANALYSIS **L: 6 Hrs**

Time response, test signals, obtaining dynamic response of first order and second order linear systems for different inputs through simulation – Transient response specifications – Delay time, rise time, peak overshoot, undamped natural frequency, damping factor, settling time

Introduction to Frequency response, frequency domain specifications, Excitation and response signals of systems

REALTIME SIMULATION OF AUTOMOTIVE SYSTEMS **L: 6 Hrs**

Introduction to controllers, different types of controllers, tuning of PID controller, Plant and Controller stand alone simulation, Plant and controller implementation on single target, RT simulation by Separating the plant from the controller, Controller and plant on real time target

Practical

P: 30 Hrs

List of Exercises:

(Note: The Simulation tutorial given in the syllabus is not for the End semester Exam)

1. Mathematical modelling of elementary systems using simulink
2. Modelling of suspension system using simulink and simscape
3. Determination of time response parameters for an automotive system using simulink.
4. Multibody dynamic simulation of a simple system using Matlab
5. Implementation of controller to a simple automotive system
6. Tuning of PID controller
7. Simulation of a cruise control system using dSPACE

Theory : 30 Hrs	Tutorial: 30 Hrs	**Total Hours: 60**

References:

1. Peter Wilson and H.AlanMantooth “Model based Engineering for complex Electronics system” 2013,Newness
2. AgamKumarTyagi “Matlab and simulink for Engineers” Oxford Higher education,2012
3. P.D. Cha, J.J. Rosenberg & C.L. Dym, `Fundamentals of Modeling and Analyzing Engineering Systems’, Cambridge University Press, 2000
4. Rao V.Dukkipati, ‘MATLAB – An introduction with applications’, New age international publishers, 2010.
5. Web course by Zachariah chambers and Marc Herniter –Rose Hulman institute of technology on “Introduction to model based design and Advanced model based design.”
6. Reference manual: dSPACE - DS1104 R&D Controller Board, Release 2016-A – May 2016

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U17AUE0010 **AUXILIARY VEHICLE SYSTEMS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

To familiarize the students with the fundamentals of modern auxiliary vehicle systems which includes the construction and operational details of ECUs, engine auxiliaries, safety, security, comfort and driver assistance systems.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Apply the concept of embedded systems for automotive applications.
CO2: Outline the importance of stability and safety systems in automobiles.
CO3: Interface automotive sensors and actuators with microcontrollers.
CO4: Obtain an overview of vehicle comfort systems.
CO5: Review the telematics systems in modern vehicles.
CO6: Recognize the various automotive security systems.

Pre-requisite:

1 NIL

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S		W		S	M	M					S
CO2:	S	M				M	S		W	W		M		M
CO3:	S	S	S		W			M	M					S
CO4:	S	M				M	S		M	W		M		M
CO5:	S	M				M	S		M	W		M		M
CO6:	S	M				M	S		M	W		M		M

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

DIGITAL VEHICLE CONTROL SYSTEMS **L: 9 Hrs**

Modern Automotive Systems, need for electronics in automobiles, applications, Microcontroller and Microprocessors in automobiles, Input devices – oxygen sensors, fuel metering, vehicle speed sensors, detonation sensor, flow sensor, throttle position sensors, Output devices – displays, solenoids, stepper motors, and relays, Engine Control Unit.

ENGINE SYSTEMS **L: 9 Hrs**

Gasoline injection systems - throttle body injection, advanced GDI and multi point fuel injection system, Electronic ignition systems – distributor less ignition system, solid-state ignition system, electronic spark timing control, Open loop and Close loop control system, engine cooling and warm up control, detonation and idle speed control, exhaust emission control, on-board diagnostics.

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SAFETY SYSTEMS **L: 9 Hrs**

Active Safety - vehicle motion control, collision avoidance control, vehicle stabilization system, antilock-braking system, traction control system, anti-slip regulation, electronic stability program, dual circuit brakes, safety glass, bad weather equipment – wiper-washer systems.

Passive Safety - air bags, seat belt pretensioner systems, occupant and passenger safety, driver monitoring systems, pedestrian protection, collapsible steering, rollover bars, head restraints, anti-burst door locks.

COMFORT SYSTEMS **L: 9 Hrs**

Power Steering, ePAS, Cruise control, Adaptive cruise control, Transmission - fundamentals, control, types MT, AT, CVT and DCT, hill assist, HVAC – Climate Control, Tyre pressure monitoring systems, Seats, Mirrors, Sun-Roofs, Park assist, Infotainment – Car Stereo and Radio.

DRIVER ASSISTANCE SYSTEMS **L: 9 Hrs**

Telematics, global positioning systems, geographical information systems, navigation systems, voice command systems, automotive vision system, lane departure warning system, Security Systems – central lock, vehicle immobilizers, keyless entry, anti-theft technology, smart card system, number plate coding.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "Navigation and Intelligent Transportation Systems" - Ronald K. Jurgen, SAE International, USA, 1998.
2 "Electronic Engine Control Technologies" - Ronald K. Jurgen, SAE International, 2004.
3 "Intelligent Vehicle Technologies: Theory and Applications" - Ljubo Vlacic, Michel Parent & Furnio Harshima, Butterworth-Heinemann publications, 2001
4 "Automotive Electrical and Electronic Systems : Automotive Technology - Vehicle Maintenance and Repair" Tom Denton, Burlington, MA 01803, Elsevier Butterworth - Heinemann, 2012.
5 "Automotive Telematics" – Dennis Foy, Red Hat, 2002.
6 "Understanding Automotive Electronics" - Williams. B. Ribbens, 6th Edition, Elsevier Science, Newnes Publication, 2017.
7 Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive , Robert Bosch GmbH, 2014
8 "Telematics Communication Technologies and Vehicular Networks: Wireless Architectures and Applications: Wireless Architectures and Applications" Huang, Chung-Ming, IGI Global, 2009.
9 "Automotive Electricity and Electronics" - James D. Halderman, PHI Publication, 2016.

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U17AUE0011 **FUEL CELL TECHNOLOGY**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:

- To create an awareness on the recent developments in Fuel cell technology
- Develop a single cell of PEM fuel cell / Microbial fuel cell

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Identify the different components and materials used in a fuel cell
CO2: Familiarize with the safety aspects and the recent advancements in field of fuel cells
CO3: Apply the knowledge of thermodynamics and material science to understand the thermodynamic equations and electrochemical kinetics of the fuel cell
CO4: Compare the different types of fuel cells and choose an appropriate fuel cell suitable for specific application
CO5: Develop a single cell of PEM fuel cell / Microbial fuel cell on their own
CO6: Estimate the performance of the fuel cell

Pre-requisite:

1 NIL

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M	M											
CO2:			S	M		S								M
CO3:	S	S												
CO4:		M	S	M										
CO5:			S	S					M	M	M			S
CO6:			S	S					M	M	M			S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION TO FUEL CELLS **L: 9 Hrs**

Introduction – working and types of fuel cell – low, medium and high temperature fuel cells - Proton Exchange Membrane fuel cell, Solid Oxide fuel cell, Alkaline fuel cells, Molten carbonate fuel cell, Phosphoric acid fuel cell, liquid and methanol type fuel cells, Microbial fuel cell

FUEL CELLS COMPONENTS FOR AUTOMOTIVE APPLICATIONS **L: 9 Hrs**

Fuel cells for automotive applications, components of fuel cell - Membrane Electrode Assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates, materials for fuel cell- carbon fibre, Fuel cell based vehicle, technological advancements in fuel cell vehicle systems

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FUEL CELL COMPONENTS AND THEIR IMPACT ON PERFORMANCE L: 9 Hrs

Thermodynamics and electrochemical kinetics of fuel cells, Fuel cell performance characteristics – current/voltage, voltage efficiency and power density, ohmic resistance, kinetic performance, mass transfer effects on membrane electrode assembly components, fuel cell stack, bi-polar plate, humidifiers and cooling plates

FUELING - PRODUCTION AND STORAGE OF HYDROGEN L: 9 Hrs

Hydrogen storage technology – pressure cylinders, liquid hydrogen, metal hydrides, Reformer technology – steam reforming, partial oxidation, auto thermal reforming, Fuel Cell Control Systems and Ancillaries, removal of Biomass and CO

FUEL CYCLE ANALYSIS L: 9 Hrs

Introduction to fuel cycle analysis – application to fuel cell and other competing technologies like battery powered vehicles, SI engine fuelled by natural gas and hydrogen and hybrid electric vehicle, road map of fuel cells to market- concern and challenges

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "Electric & Hybrid Vehicles – Design Fundamentals" - Iqbal Hussain, CRC Press, Second Edition, , 2011

2 "Electric Vehicle Technology Explained", James Larminie, John Wiley & Sons, 2003

3 "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, theory and design", Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010

4 "Fuel Cell Technology Handbook- SAE International" - Gregor Hoogers, CRC Press ISBN 0-8493-0877-1-2003.

5 "Fuel Cells for automotive applications", professional engineering publishing UK. ISBN 1-86058 4233, 2004.

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U17AUE0012

AUTOMOTIVE COMMUNICATION PROTOCOLS

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provide knowledge in concepts of acquiring ECU data, storage and exchange of data for ECU Communication in-vehicle network systems.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Outline the concepts of Communication Protocols
CO2: Compare the different communication protocols
CO3: Select suitable communication protocols for Automotive Application
CO4: Develop and understand Embedded C code for CAN Protocol
CO5: Understand the in-vehicle networking protocols in automobile
CO6: Apply the knowledge to In vehicle network diagnostics

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M		S											
CO2:		S	S											
CO3:	S	M												S
CO4:				S	S				M	M	M			M
CO5:			S	S	S				M	M	M			M
CO6:			S	S	S				M	M	M			S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

EMBEDDED NETWORKING **L: 9 Hrs**

Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming -ISA/PCI Bus protocols - Firewire USB bus – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types – Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs.

CONTROLLER AREA NETWORK (CAN) PROTOCOL **L: 9 Hrs**

History and foundation of CAN, CAN Applications, Main characteristics of CAN, CAN in OSI Reference Model, CAN Data Link Layer, Principles of data exchange in CAN, Arbitration, Data Frame, Remote Frame, Error detection and management in CAN, CAN physical Layer, Bit encoding, Bit timing and synchronization, Relationship between data rate and bus length, Single wire and twin wire media,

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CAN repeaters, Medium-to-medium gateway, Protocol handlers, Micro-controllers and line drivers, Time-Triggered CAN (TTCAN), CANoe based applications development.

LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL **L: 9 Hrs**

Introduction to LIN, LIN consortium, LIN specification, LIN features, Technical overview, Work flow concept, LIN operation, LIN frame format, Scheduling table, Network management of LIN cluster, LIN Transport Layer, LIN node configuration and identification, LIN diagnostics, LIN physical layer.

FLEXRAY PROTOCOL **L: 9 Hrs**

Future on board systems, Need for FlexRay, Origin of FlexRay, FlexRay consortium, FlexRay Objectives, FlexRay Features, Application requirements, Working of FlexRay, Network topologies, ECU architecture, Segment Configuration, Communication Cycles, FlexRay frame format, Timing of configuration protocol, Error control, and FlexRay core mechanisms, Coding and Decoding, Medium Access Control, Frame and Symbol Processing, Clock Synchronization, FlexRay Components.

IN VEHICLE NETWORK DIAGNOSTICS **L: 9 Hrs**

Process of Automotive Fault Diagnostics, Fault Codes, Vehicle Systems (open-loop and closed-loop), On- and Off- Board Diagnostics, OBD-I, OBD-II, Engine Analyzers, Steps taken to diagnose a fault, Diagnostics Protocol-KWP2000, SAE-J1587, SAE-J1708 and Case Study

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Multiplexed Networks for Embedded Systems - by Dominique ParetPublisher: John Wiley & SonsRelease Date: July 2007.

2 Understanding and Using the Controller Area Network Communication Protocol: Theory and Practice -Marco Di Natale(Author), Haibo Zeng(Author), Paolo Giusto(Author), ArkadebGhosal – springer 2012

3 Embedded Networking with CAN and CANopen Paperback – June 28, 2016 by Olaf Pfeiffer (Author), Andrew Ayre (Author), Christian Keydel (Author) -Embedded Systems Academy Inc.; 1 edition (June 28, 2016)

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U17AUE0013 INTELLIGENT VEHICLE TECHNOLOGIES

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
This course is to impart knowledge on autonomous vehicle and driver assistant systems and also the architectural overview of IoT

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Gain knowledge on different driver assistant system of autonomous vehicle and their applications
CO2: Understand the Radio communication technologies for Intelligent Vehicle
CO3: Identify different control techniques
CO4: Select the appriporiate architectures for motion autonomy
CO5: Understand the model of autonomous vehicles needed in road applications
CO6: Apply IoT configurations for Intelligent Vehicle

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S				S	S		S					S	S
CO2:	S	M			S	S		S					S	S
CO3:	M	M			S	S		S					S	S
CO4:	M				S	S		S					S	S
CO5:	M				S	S		S					S	S
CO6:	S				S	S		S					S	S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

AN INTRODUCTION TO AUTONOMOUS DRIVING TECHNOLOGIES L: 9 Hrs
Levels of Driving Automation - Architecture for Autonomous System – Hardware and Software Architecture - Computer vision – Deep learning - Sensor fusion – localization - path planing – decisdition and Control - System intergration .

RADIO COMMUNICATION AND INTELLIGENT- TRANSPORTATION-SYSTEMS L: 9 Hrs
Introduction – ITS communication systems, Multimedia communication in a car, Current ITS communication systems and services - Inter-vehicle communication system - Road-vehicle communication system - Device technologies.

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INTELLIGENT VEHICLE DECISION AND CONTROL TECHNOLOGIES L: 9 Hrs

Adaptive control system techniques - Adaptive control - an overview - System models for adaptive control- Design of self tuning controllers - Fuzzy control systems - Fuzzy control of distance and tracking.

DECISIONAL ARCHITECTURES FOR MOTION AUTONOMY L: 9 Hrs

Introduction - Robot control architectures and motion autonomy - Sharp control and decisional architecture for autonomous vehicles - Motion planning for vehicles - Trajectory planning and state time space - Nonholonomic path planning.

IOT – INTERNENT OF THINGS L: 9 Hrs

Introduction of IoT - IoT – architecture, Basic Components ,Network Protocol Stack - M2M and IoT Technology Fundamentals - Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management - Applications of IoT.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Intelligent Vehicle Technologies - Ljubo Vlacic, Michel Parent and Fumio Harashima,“”, Butterworth-Heinemann publications, Oxford, 2001.

2 Internet of Things: A Hands-On Approach Paperback – 2015 by Arsheep Bahga (Author), Vijay Madisetti (Author) - Orient Blackswan Private Limited - New Delhi; First edition (2015)

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AUTOMOTIVE TECHNOLOGY & MANAGEMENT

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U17AUE0014 **OFF ROAD VEHICLES**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Impart knowledge on different types of special purpose vehicles and their systems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Categorise vehicles based on their specification.
CO2: Infer the different types of subsystem and its functioning used in the construction of special purpose vehicle
CO3: Classify and observe the application of special purpose vehicles in construction activities.
CO4: Explain various safety systems used in Utility and military vehicles.
CO5: Interpret kinematics used in the off-road vehicles to understand its operational stability.
CO6: Identify the design requirements of tracked vehicles.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M	M							M	M				
CO2:	M	M							M	M		M		
CO3:	M	M							M	M				
CO4:	M	M	M						M	M		M		
CO5:	S	S	M						M	M			M	
CO6:	S	S	M						M	M			S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests	2	
3	End-Semester Examination	3	

LAYOUT AND REQUIREMENTS **L: 9 Hrs**
Requirements of Off Road vehicles- Classification of Off Road vehicles-Construction layout, drive, capacity based on ARAI, Frame, Engine Location, type of wheel, Transmission, Multi-axle vehicles and applications.

TRACTORS **L: 9 Hrs**
Classification of tractors-lay out of wheeled tractor- power transmission system- steering system- accessories of wheeled tractors- hydraulic control system- power take off unit and special implements

EARTH MOVING MACHINES **L: 9 Hrs**
Earthmovers –Dumpers-types, Body construction and transmission, loaders- types-single bucket, Multi-bucket, rotary and backhoe, Body construction and transmission – dozers- types and utilities. Excavators- scrappers, drag and self-powered types, Power take off, special implements. Bush cutters, stumpers, tree dozer, rippers. – Power -and capacity of earth moving machines

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MILITARY AND SPECIAL UTILITY VEHICLES **L: 9 Hrs**

Special features and constructional details of tankers, gun carriers and transport vehicles. Oil tankers-Articulated vehicles, working -features of Ambulance, fire extinguishing vehicle. Mobile Cranes: Basic characteristics of truck cranes, stability & design features, control systems & safety devices

VEHICLE SYSTEMS **L: 9 Hrs**

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system.

Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for Dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 "Construction, planning, equipment and methods ",Robert L Peurifoy, Tata McGrawel Hill Publishing company Ltd.

2 "Farm machines and equipments" , Nakra C.P.,Dhanparai Publishing company Pvt. Ltd

3 "Road making machinery", Abrosimov.K. Bran berg.A and Katayer.K., MIR Publishers,Moscow, 1971

4 "Construction planning and equipment", Satyanarayana. B., standard publishers and distributors, New Delhi.

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U17AUE0015 **TYRE TECHNOLOGY**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provide the fundamental knowledge about the construction, performance and dynamic behaviour of automotive tyres.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the various methods of tyre manufacturing.
CO2: Identify the forces and moments acting on tyres.
CO3: Explain wear possibilities, their causes and measurements
CO4: Estimate the safety of tyres and its failure analysis
CO5: List the types of tyre testing methods
CO6: Summarize Tyre retreading and recycling.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M											M	S	
CO2:	M	W											S	
CO3:	M	M				S	W						S	
CO4:	S	W	W			S	W	M				S	S	
CO5:	M	M										M	S	
CO6:	S	S				S	W					S	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION TO BASICS OF TYRES **L: 10 Hrs**

Types of tyres, tyre components and its role, tread patterns, outline of production of tires, Requirements and function of tyres – Tyre Performance Criteria – Indoor Test and Outdoor Test - Tyre Manufacturing - Compound Preparation - Basic concepts of Tread Extrusion - Effect of viscosity & temperature on extrusion - Die swell & shrinkage phenomenon - Calendering - Tyre Assembly – Curing – Inspection - Quality Control Tests.

TYRE FORCES AND MOMENTS **L: 8 Hrs**

Forces and Moments – Rolling Resistance – Cornering Properties – Slip Angle and Cornering Force – Performance of Tyre on Wet Surface – Ride Properties of Tyres – Study of Tyre types based on different road conditions and applications.

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RUBBER ABRASION AND TYRE WEAR **L: 8 Hrs**

Sliding Abrasion – Tyre Wear – Influence of Road Surface – Driving Influences – Speed and Load Distributions – Road Wear and Force Distribution – Tyre Construction

TYRE RETREADING, TYRE DURABILITY AND FAILURE ANALYSIS **L: 10 Hrs**

Defects of tyres – Tyre classification for defects – causes and discussions - Examination of: (i) Returned tyres (ii) Tyres for retreading - Norm of tyre adjustments for fast wear, poor retreading Bead/casing failures. Hot and cold process.

Service - Maintenance Safety- On Vehicle- In-Service Safety - Fundamentals Of Tyre Durability - Nature Of Tyre Durability- Deflection, Heat, Speed, Tyre Structural Failures - Common In-Service Tyre Failure Modes - Run Low/ Flux Break- Tyre Tread Bead Detachment- Rapid Air Loss - Over Deflection- Intra-Carcass Pressurization- Cuts And Punctures- Improper Repair

NON-DESTRUCTIVE TESTS AND INSPECTIONS, RECOVERY AND RE-USE **L: 9 Hrs**

Introduction of Inspection Techniques - X-Ray Examination – Shearography – Ultrasound – Eddy Currents - Recovery and Re-use Reclaiming Technology – Surface Treatment – Grinding and Pulverization technology – Devulcanization Technology Use of Recovered Tyre rubber.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 J. Y. Wong, “Theory of Ground Vehicles”, 4th Edition“2008
2 US Department of Transportation., “The Pneumatic Tire”,February 2006
3 Bireswar Banerjee, “Tyre Retreading” Smithers Information Ltd., 2015
4 V. L. Shulman, “Tyre Recycling” Rapra Review Reports Volume 15, Number 7, 2004
5 Tom French, Tyre technology, The University of Michigan, 1989.

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U17AUE0016 **VEHICLE TESTING AND VALIDATION**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Familiarize the tests to be performed on the vehicle and its subsystems.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Outline the basic measurement systems.
CO2: Examine the vehicle body strength using crash tests.
CO3: Explain the various engine performance testing methods.
CO4: Estimate the different vehicle test parameters and its influence on fuel economy.
CO5: Summarize the tests performed on steering, suspension and its impact on driving stability.
CO6: List the tests conducted to analyse the transmission, brakes and wheel performance.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M				S							W	M	
CO2:	S	M			S		M					M	S	
CO3:	M	M			S		M					W	S	
CO4:	M	M			S		M					W	M	
CO5:	M	M			S	M	W					W	M	
CO6:	M	M			S		W					M	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION TO MEASUREMENT SYSTEMS **L: 3 Hrs**
Introduction - static and dynamic measurement - closed and open loop system - Requirements and characteristics

VIBRATION MEASUREMENT AND VEHICLE BODY STRENGTH ANALYSIS **L: 9 Hrs**
Instrument – Accelerometer and signal conditioning, Graphical presentation. Dynamic simulation sled testing, methodology, Vehicle acceleration measurement and Documentation.
Dolly roll over test, dolly role over fixture, photographic / video coverage, instrumentation. Vehicle roof strength test – test procedure and test measurements. Door system crush test - procedure and measurements.

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ENGINE TESTING & FUEL ECONOMY **L: 8 Hrs**

I.S Code for Engine testing – Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers.

Field Testing: Type I & II, test route selection, vehicle test speeds, cargo weights, driver selection, test data form, calculations. Test on rough terrain, pot holes with laden and unladen conditions.

VEHICLE STEERING, SUSPENSION AND STABILITY TEST **L: 14 Hrs**

Analysis of constant radius test, constant steer angle test, constant speed variable radius test, constant speed variable steer angle test, response gain test.

Measurement of dimensional and geometric characteristics, measurement of centre of gravity position, measurement of moments and products of inertia, measurement of suspension kinematic characteristics, measurement of suspension elastic and coulomb friction characteristics, measurement of shock absorber characteristics.

WHEELS AND TRANSMISSION AND BRAKE PERFORMANCE TEST **L: 11 Hrs**

Friction Clutches - Diagnosing of Slippage, Drag, Binding and Vibration - Performance of Automatic Transmission Systems

Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations. Impact test – road hazard impact test for wheel and tyre assemblies, test procedures, failure criteria and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements. Parking brake – drawbar pull test, grade holding test.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1. Crouse W H and Anglin D L., “Automotive Mechanics”’ Tata McGraw Hill Publishing Company, 2004
2. Rangan, Mani and Sharma, “Instrumentation”, Tata McGraw Hill Publishers, New Delhi, 2004
3. Stockel M W, “Auto Mechanics Fundamentals”, Good Heart-Wilcox Co., Inc., 2000
4. Jain R K “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
5. Martyr A. J, Plint M. A, “Engine Testing Theory and Practice”, 3rd edition, Butterworth-Heinemann, 2007.
6. Ken Pickerill, “Automotive Engineering Engine Performance Shop Manual”, Cengage Learning, 2010
7. SAE Hand book, Vol. 3, SAE Publications, 2000
8. Tim Gilles, “Automotive Service”’ Delmar Publishers, 1998.
9. Beckwith TG and Buck N L, “Mechanical Measurements”, Addition Wesley Publishing Company Limited, 1995
10. Giles J. G, “Vehicle Operation & Performance”.
11. Crouse. W. H, Anglin. D. L, “Motor Vehicle Inspection”, McGraw Hill, 1978.

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U17AUE0017 **ENTREPRENEURSHIP DEVELOPMENT**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provide knowledge on Entrepreneurship to be become responsible Entrepreneurs.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: List the merits and demerits of entrepreneurial culture
CO2: Develop the entrepreneurial characteristics to understand strength and weakness
CO3: Utilize the opportunity
CO4: Formulate a business plan to solve problems
CO5: Choose the processes involved in setting up a business
CO6: Compare the role of government and banks in promoting entrepreneurship.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:														
CO2:														
CO3:					S	S	S	S	S	S	S	S		
CO4:					S	S	S	S	S	S	S	S		
CO5:					S	S	S	S	S	S	S	S		
CO6:					S	S	S	S	S	S	S	S		

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

ENTREPRENEURSHIP **L: 9 Hrs**
Entrepreneur - Types of Entrepreneurs, Intrapreneur, Multiprener, Entrepreneurship in Economic Growth of a country, Factors Affecting Entrepreneurial Growth

ACHIEVEMENT MOTIVATION TRAINING **L: 9 Hrs**
Factors influencing a person to become on his own. Need to achieve. Training through Activities. Goal setting. Role Play. Awareness programs.

MARKET RESEARCH & MARKETING **L: 9 Hrs**
Market potential. Questionnaire for Market survey. Market research. Consumer behavior. Voice of a customer. Scope for new product. Product distribution channels.

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BUSINESS PLAN **L: 9 Hrs**

Types of business. Classification based on investment. Detailed Business Plan PPR and DPR. Feasibility study. Technical appraisal of the business. Profitability calculations. Brake-Even analysis, Demand Fore casting and Inventory. Costing and accounting. Taxes. Formalities and processes in setting up a business.

SUPPORT TO ENTREPRENEURS **L: 9 Hrs**

Sickness in small Business. Causes and Consequences, Corrective Measures. Technology Business Incubators Government Policy for funding Start Ups & Small Scale Enterprises. Role of MSME State Level. Growth Strategies in small industry. Expansion, Diversification, Joint Venture, Merger and Sub Contracting. Venture capitalists. Patents. Intellectual Property Rights.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 Khanka. S.S, "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi,2013.
2 Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
3 Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013
4 Mathew J Manimala,Princy Thomas Entrepreneurship Education: Experiments with Curriculum, Pedagogy and Target groups. Springer 2017
5 Rajeev Roy, 'Entrepreneurship', 2nd Edition, Oxford University Press, 2011
6 EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986

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U17AUE0018 **VEHICLE TRANSPORT MANAGEMENT**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provides knowledge on fleet management methods and Motor vehicle act.

Course Outcomes:
After successful completion of this course, the students should be able to:
CO1: Collect concept of personal Management objectives and functions.
CO2: Explain the Passenger transport operation.
CO3: Explain the Good Transport management Systems.
CO4: Describe the Motor Vehicle Act.
CO5: Outline the process of traffic engineering and its management.
CO6: Extend knowledge of fleet management.

Pre-requisite:
1 NIL

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:						S		S	M	M	M	M		S
CO2:			M			S		S	M		M	M		S
CO3:						S		S	M	M	M	M		S
CO4:						S	S	S		M		M		S
CO5:	M					S	M	S	M	M	S			S
CO6:						S		S	M	M	M	M		S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION **L: 9 Hrs**

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

PASSENGER TRANSPORT OPERATION **L: 9 Hrs**

Structure of passenger transport organizations- Typical depot layouts- Requirements and Problems on fleet management- Fleet maintenance- Planning -Scheduling operation & control- Personal & training-training for drivers & conductors- Public relations, Propaganda, publicity and passenger amenities-Parcel traffic - Theory of fares-Basic principles of fare charging- Differential rates for different types of services- Depreciation & debt charges- Operation Cost and Revenues- Economics & records

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GOODS TRANSPORT OPERATION **L: 9 Hrs**

Structure of goods transport organizations- Scheduling of goods transport- Management Information System (MIS) in passenger / goods transport operation- Storage & transportation of petroleum products- Advance Techniques in Traffic Management- Traffic navigation- Global positioning system.

MOTOR VEHICLE ACT **L: 9 Hrs**

Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, Power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive.

TRAFFIC ENGINEERING & MANAGEMENT **L: 9 Hrs**

Road user characteristics, human and vehicle characteristics, speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams; Traffic volume Measurement, equipment for flow measurement, Density measurement, Travel time measurement, Automotive traffic measurement devises, Traffic signal design, Parking study, accident study, congestion study, toll operation, pedestrian study.

Theory : 45 Hrs	Tutorial: 0 Hrs	**Total Hours: 45**

References:

1 John Duke - Fleet Management – McGraw-Hill Co, USA -1984.
2 Government Motor Vehicle Act – Eastern Book Company, Lucknow – 1989
3 Kitchin.L.D., - Bus Operation - Illiffee and Sons Co., London, III edition – 1992
4 Roess, RP., McShane, WR. and Prassas,ES.(1998), Traffic Engineering,Prentice Hall
5 May,A. D.(1990), Fundamentals of Traffic Flow,Prentice Hall.
6 The motor vehicle Act 1939 - Ejaz Ahemad, Ashok law house, India – 1989.
7 Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna

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U17AUE0019 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provides knowledge on the application of hydraulic and pneumatic systems.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Identify the graphical representation of all the hydraulic and pneumatic components
CO2: Describe the concept used to design the systems
CO3: Illustrate the working of hydraulic components
CO4: Summarize the working of pneumatic components
CO5: Design and implement simple fluid power systems common in industrial applications using commercial components
CO6: Familiarize the actual fluid power circuits used in Automotive and Industrial Applications

Pre-requisite:
1 U17AUI4202 - Fluid Mechanics and Machinery

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M								S			S	
CO2:	S				M								S	
CO3:	S						M					S	S	
CO4:	S						M					S	S	S
CO5:	S	M	S		M		S					S	S	S
CO6:	S		M	M	M		M						S	S

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION TO FLUID POWER & PRINCIPLE **L: 7 Hrs**

Introduction to fluid power control - Hydraulic and Pneumatics - Selection criteria, application of fluid power, Application of Pascal's law, Equation, Transmission and Multiplication of force pressure losses - fluids, selection and properties - ISO symbols

FLUID POWER DRIVES **L: 11Hrs**

Fluid power drives – Pumps - working principle and construction details of gear, vane and piston pumps, hydraulic motor, Hydrostatic transmission drives and characteristics - Hydraulic supply components - Pneumatic power supply - Compressor, air distribution, air motors.

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FLUID POWER ELEMENTS **L: 9 Hrs**

Control valves - pressure, flow direction - working principles and construction - Special type valves- proportional and servo - Selection and actuation methods.

Actuators - Selection and specification, cylinders - mounting, cushioning - Fluid conditioning elements - Accumulators.

HYDRAULICS AND PNEUMATICS CIRCUITS DESIGN **L: 9 Hrs**

Design of Hydraulic and Pneumatic circuits for automation, Selection and specification of circuit components, sequencing circuits, cascade and Karnaugh - Veitch map method - Regenerative, speed control, Synchronizing circuits

ELECTRO-PNEUMATICS **L: 9 Hrs**

Use of electrical timers, switches, solenoid, relay, proximity sensors - Electro pneumatic sequencing Ladder diagram.

PLC: – elements, function and selection - PLC programming - Ladder and different programming methods - Sequencing circuits.

Theory : 45 Hrs Tutorial: 0 Hrs **Total Hours: 45**

References:

1 Anthony Esposito, “Fluid power with applications” , 5th Edition, Pearson Education 2003.
2 Majumdar, “Oil Hydraulics: Principles and Maintenance”, Tata McGraw Hill, 2004
3 Majumdar, “Pneumatic system: Principles and maintenance”, Tata McGraw Hill,2004
4 Andrew Parr, “Hydraulics & Pneumatics” Jaico Publishing House,2004
5 William W. Reaves, “Technology of Fluid Power”, Delmer Publishers,1997
6 Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006.
7 Peter Rohner,” Fluid Power Logic Circuit Design” MacMillion Press Ltd., 1990.
8 Micheal J, Pinches and Ashby, J.G., “Power Hydraulics”, Prentice Hall, 1989.
9 Dudelyt, A Pease and John J Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

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U17AUE0020 **AUTOMOTIVE AERODYNAMICS**

L	T	P	J	C
3	0	0	0	**3**

Course Objective:
Provides knowledge on basic principles of aerodynamics for the design of vehicle body.

Course Outcomes:
After successful completion of this course, the students should be able to:

CO1: Understand the fluid flow concepts for aerodynamic studies in vehicle.
CO2: Understand the importance of aerodynamics for automobiles.
CO3: Explain the aerodynamic drag concepts and aerodynamic development strategies for car.
CO4: Analyze various aerodynamic shapes of cars and commercial vehicles.
CO5: Explain the vehicle lateral stability due to side wind, wind noise and occurrence of dirt accumulation on vehicle.
CO6: Apply the concept of wind tunnel and numerical methods for aerodynamic design of automobiles.

Pre-requisite:
1 U17AUI4202 - Fluid Mechanics and Machinery

CO-PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	M							S	M		S	S	
CO2:	S	M							S	M		S	S	
CO3:	S	M	M						S	M		S	S	
CO4:	S	S	S						S	M		S	S	
CO5:	S	S	M						S	M		S	S	
CO6:	S	S	M		M				S	M		S	S	

Course Assessment methods:

Direct		Indirect	
1	Assignments	1	Course Exit Survey
2	Continuous Assessment Tests		
3	End-Semester Examination		

INTRODUCTION **L: 9 Hrs**

Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

AERODYNAMIC DRAG OF CARS **L: 9 Hrs**

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, low drag profiles.

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SHAPE OPTIMIZATION OF CARS **L: 9 Hrs**

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.

VEHICLE HANDLING **L: 9 Hrs**

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.

WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS **L: 9 Hrs**

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

Theory : 45 Hrs Tutorial: 0 Hrs **Total Hours: 45**

References:

1 Hucho.W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd., - 1997.
2 Pope - "Wind Tunnel Testing " - John Wiley & Sons - 2nd Edition, New York - 1974.
3 Automotive Aerodynamic: Update SP-706 - SAE – 1987
4 Vehicle Aerodynamics - SP-1145 - SAE – 1996.

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ONE CREDIT COURSES

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U17AUC0001 MOTORSPORTS ENGINEERING

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Classify various motorsport events across the globe
CO2: Identify the rules and regulation for the different motor sport events
CO3: Recognize the career opportunities in motorsport engineering

Pre-requisite:

1. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:		S			S							S	S	S
CO2:		S				S	S		M	S		S	S	S
CO3:						S					S		S	S

Course Assessment methods:

Direct	Indirect
1. Quiz	1. Exit Survey
2. Seminar / Case Study Report	

INTRODUCTION TO MOTORSPORT ENGINEERING **2 Hours**

The history of motorsport engineering-Review of motorsport engineering-Pioneers of Motorsport engineering -Motorsport technology evolution review.

LIST OF MOTORSPORT COMPETITIONS FOR STUDENTS **3 Hours**

A brief look at all the events students can take part to develop their skills - Formula SAE - Baja SAE - SAE Super mileage.

PROFESSIONAL MOTORSPORT EVENTS **4 Hours**

The various types of professional motorsport events that take place around the world - Cars – Formula One, World rally championship, Touring car championship, GP2, GP3, World Endurance Racing Championship, dirt track racing, NASCAR, Indy Car, Cross Country rallies, drag racing - Motorcycles – MotoGP, Superbike, Endurance, Motocross, Supermoto, Freestyle, Trials, Cross-country rallies, Speedway, Board track, drag racing

RULES AND REGULATIONS OF MOTORSPORTS **3 Hours**

Introduction about the rule book - About - the world governing bodies of the sport - Why the rule book keeps changing - How to interpret the rule book- Rules for car races - Rules for bikes races

CAREER IN MOTORSPORTS ENGINEERING **3 Hours**

Motorsport Engineer Race Driver / Rider - Test Driver / Rider - Design engineer - Race technician -Aerodynamics Engineer - Race official / steward

Total Hours: 15

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U17AUC0002 **AUTOMOTIVE STYLING**

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the design trends of concept cars

CO2: Apply the concept of ergonomics in designing concept cars

Pre-requisite:

1. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	W											S	
CO2:		M										M	S	

Course Assessment methods:

Direct	Indirect
1. Quiz	1. Course Exit Survey
2. Assignment / Case study	

DESIGN EXPRESSIONS **4 Hours**

Design methodology, Lifestyle board, Mood board, Theme board, Design trends, Design movements, Application of design principles and product aesthetics

INTRODUCTION TO CONCEPT CARS **4 Hours**

Importance of concept cars, Blending technology, Form in concept cars

CAR DESIGN **4 Hours**

Art and colour, Product styling, Introduction to human factors engineering, Digital design, Concept to reality, Auto show vehicles

VISUAL FACTORS IN DESIGN **3 Hours**

Colour harmony, Colour in design, Artist's spectrum, Basic color schemes

Total Hours: 15

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U17AUC0003 **ELECTRONIC ENGINE MANAGEMENT SYSTEMS**

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Familiarize the importance of ECU for better performance of engines.

Pre-requisite:

1. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:		S									W			S

Course Assessment methods:

Direct	Indirect
1. Quiz	1. Course Exit Survey
2. Assignment / Case study	
3. Test	

Topics covered

- An overview of Engine Management System
- Current trends in automotive electronic engine management system
- Control of SI & CI engines for better performance and low emissions
- Closed loop control of engine parameters of fuel injection and ignition.
- Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation.
- Electronics emission control techniques

Total Hours 15

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U17AUC0004 INTELLECTUAL PROPERTY RIGHTS

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the IPR and its classification

CO2: Understand the Patens for Inventions

Pre-requisite:

1. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M		S		S	S	S			S	S	S	**S**	
CO2:	M		S		S	S	S			S	S	S	**S**	

Course Assessment methods:

Direct	Indirect
1. Test	1. Course Exit Survey
2. Quiz	
3. Assignment / Case study	

Module:

1.Overview on IPR and its classification **3 Hours**

2.Patents **4 Hours**

3.International Conventions related to IPR **4 Hours**

4.Patens for Inventions in Automotive Engineering - Case Studies **4 Hours**

Total Hours: 15

References:

1. T. M Murray and M.J. Mehlman, Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons 2000
2. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010

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U17AUC0005 VEHICLE MAINTENANCE

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Basics of maintenance & workshop statements preparation

CO2: Understand the Engine, Chassis, Electrical Maintenance systems

Pre-requisite:

2. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	M		S		S	S	S			S	S	S		S
CO2:	M		S		S	S	S			S	S	S		S

Course Assessment methods:

Direct	Indirect
1. Test	1. Course Exit Survey
2. Quiz	
3. Assignment / Case study	

MAINTENANCE OF RECORDS AND SCHEDULES **2 Hours**

Preventive (scheduled) and breakdown (Unscheduled) maintenance, requirements of maintenance, preparation of check Lists, Inspection schedule, maintenance of records, log sheets.

ENGINE MAINTENANCE **4 Hours**

List of Engine components and cleaning methods, visual and Inspections, minor reconditioning of various components, Reconditioning methods, special tools used for maintenance.

CHASSIS MAINTENANCE **6 Hours**

Maintenance of Automobile clutch, gear box, drive, suspension, Brake and Steering systems.

ELECTRICAL SYSTEM MAINTENANCE **3 Hours**

Testing methods battery, starter motor, charging, Ignition and lighting Systems. Checking and servicing of dash board instruments.

Total Hours: 15

References:

1. John Doke, “Fleet Management”, McGraw Hill Co. 1984.
2. James D Halderman, “Advanced Engine Performance Diagnosis”, PHI, 1998.
3. Service Manuals from Different Vehicle Manufacturers.

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U17AUC0006 LEAN MANUFACTURING

Course Outcomes

On successful completion of the course the learner would be able to:

CO1: Understand the Concept of Six Sigma and Value Engineering

CO2: Understand the Concept of Reliability Engineering and Learn Manufacturing

Pre-requisite:

1. Nil

CO-PO/PSO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1:	S	S	S	S	S	W	M					S	**S**	
CO2:	S	S	S	S	S	W	M			M		S	**S**	S

Course Assessment methods:

Direct	Indirect
1. Test	1. Course Exit Survey
2. Quiz	
3. Assignment / Case study	

Course Description

Lean Manufacturing is about creating value. The Lean process starts with creating value for the ultimate customer, which requires providing the right product at the right time for the specified price. While all manufacturing attempts to do this, what makes Lean Manufacturing distinct is the relentless pursuit and elimination of waste. Students will learn the concepts and tools of Lean, which include types of waste, visual management, 5S, value stream mapping, A3, & flow.

Module:

1. Definition of Lean
2. Importance of Lean
3. Application of Lean Tools
4. Difference between Value-Added and Non-Value-Added
5. Preparing to Work in a Lean Environment
6. Dos and Don'ts for Lean Terms
7. Traditional Manufacturing
8. Introduction to New Advanced Lean Tools
9. Eight Wastes
10. Introduction to Key Terms
11. Visual Controls
12. 5S and Standardized Work

Total Hours: 15

Reference

1. "The Machine that Changed the World" - J.P. Womack, D.T. Jones, D. Roos, Free Press, 1990 (2007 in paperback). ISBN-13: 978-0-7432-9979-4.
2. "The Toyota Way" J.K. Liker, McGraw Hill, 2004. ISBN 0-007-139231-9
3. "Learning to See" - M. Rother, J. Shook, Lean Enterprise Institute, 2009. ISBN: 9978-0-9667843-0-5

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