26.09.2022

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	**2**	**2**	**0**	**0**	03	50	50	100	3
2	IPCC 21AU32	Material Science and Metallurgy	AU	3	0	2	Decided by the faculty	03	50	50	100	4
3	IPCC 21AU33	Manufacturing Processes	AU	3	0	2	Decided by the faculty	03	50	50	100	4
4	PCC 21AU34	Engineering Thermodynamics	AU	2	2	0	-	03	50	50	100	3
5	PCCL 21AUL35	Basic Automobile Engineering Laboratory	AU	0	0	2	-	03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	1	0	0	-	01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21AU38X	Ability Enhancement	TD: Concerned department	If offered as Theory Course				01	50	50	100	1
				1	0	0	0					

		Course – III	PSB: Concerned Board	If offered as lab. course				02				
				0	0	2	**0**					
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.

L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-** Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47**Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A)Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses. Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses. Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III			
21AU381	Rural Development	21AU383	Additive Manufacturing
21AU382	Bharat Stages (BS) of Emission Standards	21AU384	Clay modelling

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT41	Complex Analysis , Probability and Linear Programming	Maths	2	2	0	-	03	50	50	100	3
2	IPCC 21AU42	Mechanical Measurement	AU	3	0	2	Decided by the faculty	03	50	50	100	4

		and Metrology										
3	IPCC 21AU43	Fluid Mechanics and Fluid Machines	AU	2	2	2	Decided by the faculty	03	50	50	100	4
4	PCC 21AU44	Theory of Machines	AU	2	2	0	Decided by the faculty	03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0	-	02	50	50	100	2
6	PCCL 21AUL46	Computer Aided Machine Drawing	AU	0	1	2	-	03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0	-	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21AU48X	Ability Enhancement Course- IV	AU	If offered as theory Course				01	50	50	100	1
				1	0	0	0					
				If offered as lab. course				02				
				0	0	2	**0**					
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0	0	01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology

(BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course – IV

21AU481	Theory and Applications of Sensors and Actuators	21AU483	Autonomous vehicles
21AU482	Earth Moving Equipment	21AU484	Drive Cycles of Electric Vehicles

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a **mandatory internship** of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2)Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centres or Incubation centres. Innovation need not be a single breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3)Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

26.09.2022

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations 2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21AU51	Heat and Mass Transfer	AU	2	2	0	-	03	50	50	100	3
2	IPCC 21AU52	Fundamentals Of Electrical Vehicles	AU	3	0	2	Decided by the faculty	03	50	50	100	4
3	PCC 21AU53	Design of Automobile components	AU	2	2	0	-	03	50	50	100	3
4	PCC 21AU54	Automotive Transmission	AU	2	2	0	Decided by the faculty	03	50	50	100	3
5	PCCL 21AUL55	Automotive Engine and EV drive Components Lab	AU	0	0	2	-	03	50	50	100	1
6	AEC 21AU56	Research Methodology& Intellectual Property Rights	TD: Any Department PSB: As identified by University	2	0	0	-	02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21AU58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses 1	0	0	-	01	50	50	100	1
				If offered as lab. courses 0	0	2	-	02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course – V

21AU581	Automotive Heating, Ventilation and Air conditioning	21AU583	Programming for Automobile engineers
21AU582	Digital Twin	21AU584	Battery management system

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT –Internship, HSMC: Humanity and Social Science & Management Courses. L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.
Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

26.09.2022

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21AU61	Management &Entrepreneurship	AU	3	0	0	Decided by the faculty	03	50	50	100	3
2	IPCC 21AU62	Automotive chassis and suspension	AU	3	0	2	Decided by the faculty	03	50	50	100	4
3	PCC 21AU63	Vehicle Body Engineering and Safety	AU	3	0	0	Decided by the faculty	03	50	50	100	3
4	PEC 21AU64x	Professional Elective Course-I	AU	3	0	0	Decided by the faculty	03	50	50	100	3
5	OEC 21AU65x	Open Elective Course-I	Concerned Department	3	0	0	-	03	50	50	100	3
6	PCCL 21AUL66	Modelling & ANALYSIS LAB	AU	0	0	2	-	03	50	50	100	1
7	MP 21AUMP67	Mini Project	AU	Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective – I

21AU641	Propulsion System for Electric And Hybrid Vehicles	21AU643	Hydraulics and Pneumatics
21AU642	Principles of Alternate Energies	21AU644	Finite Element Methods

21AU645	**Autonomous vehicles**		

Open Electives – I offered by the Department to other Department students			
21AU651	Renewable Energy	21AU653	Basics of Thermal Engineering
21AU652	Fundamentals Of I.C. Engines	21AU654	Engineering Economics

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.

L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses (PEC):

A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.

(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.

The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be

based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centres of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

26.09.2022

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations 2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21AU71	Application Of AI in Automotive Vehicles	AU	3	0	0	Decided by the faculty	3	50	50	100	3
2	PCC 21AU72	Automotive Electrical and Electronic Systems	TD: AU/ECE/EEE PSB: AU	3	0	0	Decided by the faculty	3	50	50	100	2
3	PEC 21AU72X	Professional elective Course-II	AU	3	0	0	Decided by the faculty	3	50	50	100	3
4	PEC 21AU73X	Professional elective Course-III	AU	3	0	0	Decided by the faculty	3	50	50	100	3
5	OEC 21AU74X	Open elective Course-II	Concerned Department	3	0	0	0	3	50	50	100	3
6	Project 21AUP75	Project work	AU	Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl.			g D e p	Teaching Hours /Week	Examination	e di ts

26.09.2022

No	Course and Course Code		Course Title		Theory Lecture L	Tutorial T	Practical/ Drawing P	Self -Study S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	Seminar 21AU81		Technical Seminar	AU	One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship	AU	Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective – II			
21AU721	Hybrid Vehicle Technology	21AU724	Industry 4.0 for Automotive Vehicles
21AU722	Energy Storage Systems for Electric Vehicles	21AU725	Factory Physics
21AU723	Vehicle Transport Management		

Professional Elective – III			
21AU731	Safety of Electric Vehicles	21AU734	Infotainment & Cyber Physical System
21AU732	Total Quality Management	21AU735	Noise Vibration Harshness
21AU733	Computational Fluid Dynamics		

Open Electives - II offered by the Department to other Department students			
21AU741	Energy efficiency and Management	21AU743	Human Resource Management
21AU742	Knowledge Management	21AU744	Refrigeration and Air-Conditioning concepts

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.

L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To instil responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.

(ii) Prepare the report with own sentences, avoiding a cut and paste act.

(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.

(iv) Present the seminar topic orally and/or through PowerPoint slides.

(v) Answer the queries and involve in debate/discussion.

(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question-and-answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

26.09.2022

Marks distribution for CIE of the course:

Seminar Report:50 marks

Presentation skill:25 marks

Question and Answer: 25 marks.■No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):
National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.
(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.
(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

26.09.2022

3rd Semester

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code	21MAT 31	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

The goal of the course Transform Calculus, Fourier series and Numerical techniques 21MAT 31 is

1. To have an insight on solving ordinary differential equations by using Laplace transform techniques
2. Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
3. To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving differential equations by the z-transform method.
4. To develop the proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

Teaching-Learning Process (General Instructions)

These are sample Strategies which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting
5. students' progress.
6. Show short related video lectures in the following ways:

- As an introduction to new topics (pre-lecture activity).
- As a revision of topics (post-lecture activity).
- As additional examples (post-lecture activity).
- As an additional material of challenging topics (pre-and post-lecture activity).
- As a model solution for some exercises (post-lecture activity).

Module-1	
Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of . Laplace transforms of Periodic functions (statement only) and unit-step function – problems. Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations. Self-study: Solution of simultaneous first-order differential equations. (RBT Levels: L1, L2 and L3)	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis. Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test (RBT Levels: L1, L2 and L3)	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

26.09.2022

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems. Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. Self Study: Initial value and final	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4	
Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. Self Study: Solution of Poisson equations using standard five-point formula. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. Self Study: Hanging chain problem (RBT Levels: L1, L2 and L3)	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

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

To solve ordinary differential equations using Laplace transform.

1. Demonstrate Fourier series to study the behaviour of periodic functions and theirapplications in system communications, digital signal processing and field theory.
2. To use Fourier transforms to analyze problems involving continuous-time signals andto apply Z-Transform techniques to solve difference equations
3. To solve mathematical models represented by initial or boundary value problemsinvolving partial differential equations
4. Determine the extremals of functionals using calculus of variations and solveproblems arising in dynamics of rigid bodies and vibrational analysis.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

Continuous Internal Evaluation: by BOARD

1. Methods recommended:

➢ Three Tests (60%)

➢ Written Quiz on self-study portions (20%)

➢ Module Assignments (20%)

The subject teacher shall decide the topic for the closed book test and written quiz. The teacher must announce the methods of CIE in the beginning

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be scaled down proportionally to 50 marks**
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Suggested Learning Resources:

   Text Books:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. 1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.

4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latest ed.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", Mc- Graw Hill Education(India) Pvt. Ltd 2015.
6. H.K.Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):

1. http://.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. http://www.bookstreet.in.
5. VTU e-Shikshana Program
6. VTU EDUSAT Program

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Quizzes
2. Assignments

IPCC- Material Science and Metallurgy			
Course Code	**21AU32**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

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

- Explain different crystal structures, mechanism of various types of failure, types of heat treatment processes, types and methods of manufacturing of composites.
- Draw stress strain diagram for various metals.
- Select various non-ferrous metals and alloys based on composition and properties for a given application.
- Understand the basics of Batteries and Super capacitors

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

.

MODULE-1

26.09.2022

Crystal Structure: BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections –point, line and surface imperfections. Atomic Diffusion: Flick's laws of diffusion, factors affecting diffusion. **Stress & Strains**:Introduction, Hooke's law, Stress-strain diagram for ductile and brittle materials, True stress and true strain, linear and non-linear elastic behaviour and properties, mechanical properties in plastic range, yield strength, offset yield strength, ductility, ultimate tensile strength, and toughness. Calculation of stresses in Composite sections, Shear stress and strain, Lateral strain and Poisson's ratio, Bulk modulus, Relationship between elastic constants, factor of safety, criteria for selection of factor of safety, Numerical problems on the above wherever applicable	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions (Experiments 1-4)
MODULE-2	
Analysis of Stress and Strain: Plane stress, Principal stresses and maximum shear stress, Maximum shear stress, Mohr circle for plane stress,Shear stresses on principal planes., Numerical problems on the above wherever applicable **Fracture**: Type I, Type II and Type III. **Creep**: Description of the creep phenomenon with examples, three stages of creep, stress relaxation.	
Teaching-Learning Process	. Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions (5-9)
MODULE-3 8 HOURS	
Materials for Batteries; Primary and Secondary cells, Materials used for various components in batteries -electrolytes, electrodes, separators, binders. Different types of Batteries, Performance and Manufacturing of batteries, Numerical problems on the above wherever applicable **Electrochemical Energy Storage Systems**- Fundamentals of Electrochemical Super capacitors, Fuel Cells, Battery Safety and abuse tolerance.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Demo 1-2)
MODULE-4-8 HOURS	
Heat Treatment of Metals; Annealing and its types. Normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of Aluminium-copper alloys. **Ferrous Metals:** Properties, Composition and uses of grey cast iron, malleable iron, S.G iron and steel.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, **Experiential learning through laboratory sessions: (Demo 3)**
MODULE 5- 8 HOURS	
Non-Ferrous Metals; Copper alloys-brasses and bronzes, Aluminum alloys-Al-Cu, Al-Si, Al-Zn alloys- composition, properties, advantages and disadvantages and applications. Composite Materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP' and MMC's advantages and application of composites.	

26.09.2022

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, **Experiential learning through laboratory sessions: (Exp 9, Demo 4)**
PRACTICAL COMPONENT OF IPCC (May cover all / major modules)	
Sl.NO	**Experiments**
1	Preparation of specimen for Metallographic examination of different engineering materials.
2	Identification of microstructures of plain carbon steel, tool steel, gray CI, SG iron, Brass, Bronze& composites.
3	Brinell, Rockwell and Vickers's Hardness test.
4	Fatigue Test
5	To study the defects of Cast and Welded specimens
6	Tensile, Shear and Compression tests of metallic and non-metallic specimens using Universal Testing Machine
7	Torsion Test
8	Bending Test on metallic and non-metallic specimens., Izod and Charpy Tests on M.S, and CI specimen.
9	To study the wear characteristics of ferrous, non-ferrous, and composite materials for different parameters.
9	**Demo experiments for CIE**- Identify and list the Materials used for various components in batteries -electrolytes
10	**Demo experiments for CIE**- Write typical battery specifications for different electric vehicle segments
11	**Demo experiments for CIE**- . Heat treatment: Annealing, normalizing, hardening, and tempering of steel. Hardness studies ofheat-treated samples.
12	**Demo experiments for CIE**- Non-destructive test experiments like, a. Ultrasonic flaw detection b. Magnetic crack detection, c. Dye penetration testing.

Course outcomes (Course Skill Set):

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

1 Explain different crystal structures, mechanism of various types of failure, types of heat treatment processes and types and methods of manufacturing of composites.

2 Draw stress strain diagram for various metals,

3 Select various non-ferrous metals and alloys based on composition and properties for a given application

4 Understand the basics of Batteries and Super capacitors

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally reduced for 50 marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to

be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1.Foundations of Materials Science and Engineering Smith, McGraw Hill, 2009 3 rd Edition
2. Materials Science Shackleford. & M. K. Muralidhara, Pearson Publication 2007.
3. An introduction to Metallurgy Alan Cottrell University Press India Oriental Longman Pvt. Ltd., 1974.
4. Materials Science and Engineering V. Raghavan, PHI 2002
5. Materials Science and Engineering William D. Callister Jr. John Wiley & Sons. Inc 5th Edition, 2001.
6. C. Daniel and Jurgen O. Besnard, Handbook of Battery Materials, Willey-VCH verlg-2011
7. Strength of Materials , S. S. Bhavikatti, Vikas publications House-1 Pvt. Ltd2006

1 https://nptel.ac.in/courses/113102080
2 https://nptel.ac.in/courses/113106032
3 https://www.digimat.in/nptel/courses/video/113102080/L01.html
4 https://www.youtube.com/watch?v=b4jvpYxxZco

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1 http://mrmsmtbs-iitk.vlabs.ac.in/creep.html
2 http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/physical-metallurgy/labs/index.php
3 https://www.youtube.com/watch?v=v7uS9_bUg-E

IPCC- Manufacturing Processes			
Course Code	**21AU33**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3-0-2-0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

1. To provide detailed theoretical knowledge of various methods of manufacturing, metal shaping and fabrication processes such as casting, forging, welding, soldering, brazing, rolling, press working and machining.
2. To provide detailed theoretical knowledge of construction and working of various machine tools (lathe, planer, shaper, grinding, milling etc.), metal joining equipment, foundry tools, forging tools.

3. To provide hands on training to students on various manufacturing processes through integrated practical sessions.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Foundry: Patterns and Moulds

Patterns and Pattern making:

Introduction to Foundry - Steps involved in casting, advantages, limitations and applications of casting process. Pattern making-Pattern types, allowances for pattern, pattern materials, colour coding and storing of patterns, Numerical on above wherever applicable.

Moulding:

Moulding methods and processes-materials, equipment, moulding sand ingredients, essential requirements, sand preparation and control, testing, cores and core making. Gating Runners and Risers - Solidification in castings, metallurgical aspects of Casting , Numerical problems on the above wherever applicable

Teaching-Learning Process	• Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations. Experiential learning through laboratory sessions (Exp 1-4, Exp- 10)

Module-2

Foundry technology: Casting Processes :

Sand castings, pressure die casting, permanent mould casting, centrifugal casting, precision investment casting, shell casting, Co2 casting, electro slag casting, Fettling and finishing. Defects in castings ; Melting, Pouring and Testing; Numerical problems on the above wherever applicable

Melting furnaces:

Crucible oil fired furnaces- electric furnaces-cupola, selection of furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques casting defects and their elimination, Casting inspection, Numerical problems on the above wherever applicable

Teaching-Learning Process	• Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations. Experiential learning through laboratory sessions (Exp 12)

26.09.2022

Module-3	
Basic Joining Processes **Welding:** Types of welding- Gas welding, -Arc welding, - Shielded metal arc welding, GTAW, GMAW, SAW, ESW-Resistance welding (spot, seam, projection, percussion, flash types)-thermit welding, Flame cutting - Use of Oxyacetylene, modern cutting processes. (Equipment used in each welding/cutting processes and important consumables used must be dealt in) **Special Welding Processes:** Soldering, brazing and braze welding and their application., welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys. Introduction to Electron beam and Laser welding.	
Teaching-Learning Process	• Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations. Experiential learning through laboratory sessions : (Exp 5 &11)
Module-4	
Metal Shaping and Forming **Metal working**: Elastic and Plastic deformation, Strain Hardening , **Forging:** Methods of forging, Forging hammers and presses , Numerical on the above, wherever applicable **Press working:** Process of Shearing, Drawing Squeezing, Blanking, Trimming, Notching, Lancing, Piercing, Deep drawing, Coining, and embossing, Metal working defects. **Rolling:** Hot and cold rolling technique Types of rolling operations, General description of rolling machines and processes, Numerical problems on the above wherever applicable	
Teaching-Learning Process	Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations. Experiential learning through laboratory sessions : (Exp 6 & 7)
Module-5	
Cutting tools and Machine tools: **Cutting tool materials and their geometry:** Introduction, desirable properties and characteristics of cutting tool materials, cutting tool geometry, cutting fluids and its applications, surface finish, effect of machining parameters on surface finish. **Machine Tools**: Introduction, Classification, construction, and specifications of lathe, drilling machine, milling machine, shaping machine, planning machine, grinding machine (Simple sketches showing major parts of the machines along with different operations performed on each of the machine tools) **Machining equations for cutting operations:** Turning, Shaping, Planing, Slab milling, cylindrical grinding and internal grinding. Numerical problems on the above wherever applicable	
Teaching-Learning Process	Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations. Experiential learning through laboratory sessions : (Exp 8 & 9)

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments	
1	Testing of Moulding Sand and Core Sand	
2	Sieve Analysis to find Grain Fineness number of Base Sand	
3	Clay content determination in Base Sand	
4	Preparation of sand specimens and conduction of the following tests: Compression, Shear and Tensile tests on Universal Sand Testing Machine.	

	Permeability test
5	. Use of foundry tools and other equipment. And Preparation of moulds using two moulding boxes with patterns or without patterns. (Split pattern, Match plate)
6	Calculation of length of the raw material required to prepare the model by forging.
7	Preparing minimum one forged models involving upsetting, drawing, and bending operations.
8	Preparation of two models on Lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.
9	Cutting of V- Groove/ Dovetail / Rectangular groove using a shaper, Cutting of Gear Teeth using Milling Machine.
10	Demo experiments for CIE - Core hardness & Mould hardness tests.
11	Can be Demo experiments for CIE - - Preparation of one casting -Aluminum or cast iron-
12	Can be Demo experiments for CIE - A demonstration in the workshop on welding

Course outcomes (Course Skill Set):

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

1. . Prepare moulds using moulding sand and tools and Explain different types of casting methods.
2. Fabricate simple models using various joining techniques.
3. Explain various hot and cold forming processes.
4. Produce simple models/jobs using necessary cutting tools, machining operations and machine tools.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

5. First test at the end of 5th week of the semester
6. Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

7. First assignment at the end of 4th week of the semester
8. Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and

marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally reduced to 50 Marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Manufacturing & Technology: Foundry, Forming and Welding, P. N. Rao, Tata McGraw Hill, 2nd Ed, 2003
2. Manufacturing Engineering and Technology, Serope Kalpak Jain, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed. 2006.
3. Workshop Technology, Hazara Choudhry, Media Promoters & Publishers Pvt. Ltd., Vol-II, 2004
4. Production Technology, R. K. Jain, Khanna Publications (2003)
5. Manufacturing Process, Dr. K. Radhakrishna, Sapna Book House, 5th Revised Edition 2009.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=jdFrBtHeJbs&list=PLSGws_74K01-g9nnTMBssGURHawYYQfMQ

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Experiential learning through laboratory sessions
2. Visit to machine shop in the college and experience the working of available machine tools
3. Preparation of one job on Lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring.
4. Cutting of V- Groove/ Rectangular groove using a shaper (one job)
5. Cutting of Gear Teeth using Milling Machine (one job)
6. Visit to nearest manufacturing MSME

PCC: Engineering Thermodynamics

Course Code	**21AU34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2 -2 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To define work, heat, and laws of thermodynamics, entropy, principle and working of refrigeration, jet propulsion.
2. To evaluate thermal performance of refrigeration cycles.
3. To calculation of efficiency of gas power and vapor power cycles.
4. To analyse gas power cycles

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

Teaching-Learning Process (General Instructions)

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Fundamentals of Thermodynamics:

Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Thermodynamic properties; intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics,

Temperature; concepts, various temperature scales, Numerical on the above wherever applicable **Work and Heat:** Thermodynamic definition of work; examples, sign convention, Shaft work, Electrical work, other types of work. Heat; definition, units, and sign convention., Numerical problems on the above wherever applicable	
Teaching-Learning Process	Chalk and Talk, NPTEL videos, Problem based learning (PBL), You Tube videos on work and heat
Module-2	
First law of thermodynamics and its applications: Joules experiments, Statement of the First law of thermodynamics, steady state-steady flow energy equation, important applications, analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer., Numerical problems on the above wherever applicable **Second law of Thermodynamics and its applications:** Kelvin –Planck &Clausius statement of Second law of Thermodynamics, PMM II and PMM I. Clausius Theorem & thermodynamic equivalence of the two statements; reversible and irreversible processes; Heat Engines, Numerical problems on the above wherever applicable	
Teaching-Learning Process	. Chalk and Talk, NPTEL videos, Problem based learning (PBL), PMM II and PMM I video demos
Module-3	
Entropy: Entropy; definition, a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using T-ds relations, entropy as a coordinate. Available and unavailableenergy, Numerical problems on the above wherever applicable **Pure Substances:** P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams, steam tables and its use, Numerical problems on the above wherever applicable	
Teaching-Learning Process	Chalk and Talk, NPTEL videos, Problem based learning (PBL), E- learning resources
Module-4	
Refrigeration: Vapor absorption refrigeration system, vapor compression refrigeration system; description, analysis, refrigerating effect, capacity, power required, units of refrigeration, COP, Refrigerants, and their desirable properties., Numerical **Psychrometry:** Basic definitions: dry bulb temperature, wet bulb temperature, dew point temperature; specific and relative humidifies, concept of psychrometric chart Analysis of various processes; heating, cooling, dehumidifying, and humidifying. Adiabatic mixing of moist air, Numerical problems on the above wherever applicable	
Teaching-Learning Process	. Chalk and Talk, NPTEL lecture videos, Problem based learning (PBL), VAR and VCR related You tube videos , video demos
Module-5	
ICE cycles Analysis of Carnot cycle, Otto cycle and Diesel cycles, Comparison based on performance parameters, Numerical problems on the above wherever applicable **Engine Testing and Performance:** Performance parameters, Basic measurements, Measurements of Speed, Fuel consumption, air consumption, brake power and different types of dynamometers, frictional power measurement by William's line method, Morse test and other	

methods, indicated power, performance maps, and heat balance and related numerical problems.

Teaching-Learning Process	. Chalk and Talk, NPTEL lecture videos, Problem based learning (PBL), You tube videos , lab visits

Course outcome (Course Skill Set)

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

Course Outcomes: At the end of the course the student will be able to:

1. Understand the basic and applied concepts of thermodynamics.
2. Analyse the Evaluate thermal performance of heat engines.
3. Compare the performance of heat engines.
4. Apply the concepts to solve engineering problems related to thermodynamics

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally to 50 marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Engineering Thermodynamics, P. K. Nag, Tata McGraw Hill Pub. 2002
2. Thermodynamics, An engineering approach, Yunus, A. Cenegal and Michael A.Boies, Tata Mac- Graw Hill Publishing Company, 2002
3. Applied Thermodynamics, R.K. Hegde, Sapna Book House, 2018
4. Fundamental of Classical Thermodynamics- G. J. Van Wylen andR. E. Sontang,. Wiley eastern, 1994

Web links and Video Lectures (e-Resources):

1. http://platform.sysmoltd.com/
2. http://sourceforge.net/projects/dwsim/
3. http://sourceforge.net/projects/dwsim/
4. http://platform.sysmoltd.com/
5. http://exergy.se
6. http://demonstrations.wolfram.com/CarnotCycleOnIdealGas/
7. http://demonstrations.wolfram.com/VanDerWaalsIsothermsForRealAndIdealGases/,

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL lecture videos,
2. Problem based learning (PBL)
3. Visit to Refrigeration Plant
4. Watch You tube videos on automobile vehicle AC system working

Basic Automobile Engineering Laboratory

Course Code	**21AUL35**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
		Total Marks	100
Credits	01	Exam Hours	03

Course objectives:

- To introduce the students to various tools and equipment used for dismantling and assembly of automobile systems.
- To introduce the students to various automobile assemblies and make them to gain the knowledge of various parts/components through dismantling and assembly activities.

Sl.NO	Experiments
1.	Performance test on Single Cylinder and multi cylinder SI / CI engines
2.	Study on SI and CI engines performance by changing parameters like valve timing, ignition timing, compression ratio, etc
3.	Morse test on multi cylinder engine for finding FP, IP, Indicated thermal efficiency and Mechanical efficiency
4.	Study of engine performance using alternate fuels like alcohol blends/ bio diesel / LPG.
5.	Study and testing on MPFI Engine and Variable compression ratio Engine.
6.	Exhaust Emission test of S. I. and C I Automotive engine.
	Demonstration Experiments (For CIE)
7.	Dismantling, Study and Assembling of Single cylinder / Multi Cylinder SI Engine
8.	Dismantling, Study and Assembling of Single cylinder and Multi Cylinder C I Engine
9.	Study of Oil filter, Fuel filter, Fuel injection system and Carburettor .
10.	Study of MPFI and CRDI Systems
11.	Study of Ignition Systems – Battery coil, Magneto and Electronic
12.	List charging methods and calculate power ratings of 2 and 4 wheeled electric vehicles

26.09.2022

Course outcomes (Course Skill Set):

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

1. Dismantle and assemble the various automobile systems(assemblies)
2. Sketch the automobile assemblies/systems and name the various parts
3. Explain the working of various automobile systems

Assessment Details (both CIE and SEE)

Continuous Internal Evaluation (CIE):The CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and one practical test.

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks).A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time - table of university in a batch wise with strength of students not more than 10-15 per batch.

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once, and 15% Marks allotted to the procedure part to be made zero.

Suggested Learning Resources:

- http://vlabs.iitkgp.ernet.in/rtvlas/
- https://www.thi.de/en/mechanical-engineering/laboratories/laboratory-for-engine-and-vehicle-technology/

26.09.2022

- https://www.youtube.com/watch?v=hqvEDWLPyLo
- https://www.youtube.com/watch?v=x70VqMrXrbs
- https://www.youtube.com/watch?v=oVaBqefSj0g

UHV Social Connect and Responsibility			
Course Code	21UH36	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

BE - III/IV Semester– **Common to all**

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ವಿಷಯಸಂಕೇತ(Course Code)	21KSK37/47	ನಿರಂತರಆಂತರಿಕಮೌಲ್ಯಮಾಪನದ ಅಂಕಗಳು	50
ಒಂದುವಾರಕ್ಕೆಬೋಧನಾಅವಧಿ (Teaching Hours / Week (L:T:P: S)	0:2:0:1	ಸೆಮಿಸ್ಟರ್ಅಂತ್ಯದಪರೀಕ್ಷೆಯಅಂಕಗಳು	50
ಒಟ್ಟುಬೋಧನಾಅವಧಿ Total Hours of Pedagogy	25ಗಂಟೆಗಳು	ಒಟ್ಟುಅಂಕಗಳು	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01	ಪರೀಕ್ಷೆಯಅವಧಿ	01 ಗಂಟೆ

ಸಾಂಸ್ಕೃತಿಕಕನ್ನಡಪಠ್ಯದಕಲಿಕೆಯಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದಕನ್ನಡಭಾಷೆ, ಸಾಹಿತ್ಯಮತ್ತುಕನ್ನಡದಸಂಸ್ಕೃತಿಯಪರಿಚಯಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡಸಾಹಿತ್ಯದಪ್ರಧಾನಭಾಗವಾದಆಧುನಿಕಪೂರ್ವಮತ್ತುಆಧುನಿಕಕಾವ್ಯಗಳನ್ನುಸಾಂಕೇತಿಕವಾಗಿಪರಿಚಯಿಸಿವಿದ್ಯಾರ್ಥಿಗಳ ಲ್ಲಿಸಾಹಿತ್ಯಮತ್ತುಸಂಸ್ಕೃತಿಯಬಗ್ಗೆಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನುಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕವ್ಯಕ್ತಿಗಳಪರಿಚಯವನ್ನುಹಾಗೂ ಅವರುಗಳಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನುಪರಿಚಯಿಸುವುದು.
4. ಕನ್ನಡಶಬ್ದಸಂಪತ್ತಿನಪರಿಚಯಮತ್ತು ಕನ್ನಡಭಾಷೆಯಬಳಕೆಹಾಗೂಕನ್ನಡದಲ್ಲಿಪತ್ರವ್ಯವಹಾರವನ್ನುತಿಳಿಸಿಕೊಡುವುದು.

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ(Teaching-Learning Process - General Instructions) :

These are sample Strategies, which teacher can use to accelerate the attainment of the course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧಾರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು - ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆ ಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಟಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.
3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ

26.09.2022

ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.
ಘಟಕ-1 ಲೇಖನಗಳು
1. ಕರ್ನಾಟಕಸಂಸ್ಕೃತಿ - ಹಂಪನಾಗರಾಜಯ್ಯ 2. ಕರ್ನಾಟಕದಏಕೀಕರಣ : ಒಂದುಅಪೂರ್ವಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ 3. ಆಡಳಿತಭಾಷೆಯಾಗಿಕನ್ನಡ - ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶಮತ್ತುಪ್ರೋ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

26.09.2022

ಘಟಕ-2 ಆಧುನಿಕಪೂರ್ವದಕಾವ್ಯಭಾಗ	
1. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ. 2. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ - ಪುರಂದರದಾಸರು ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು 3. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.
ಘಟಕ-3 ಆಧುನಿಕಕಾವ್ಯಭಾಗ	
1. ಡಿವಿಜಿರವರಮಂಕುತಿಮ್ಮನಕಗ್ಗದಿಂದಅಯ್ದಕೆಲವುಭಾಗಗಳು 2. ಕುರುಡುಕಾಂಚಾಣ : ದಾ.ರಾ. ಬೇಂದ್ರೆ 3. ಹೊಸಬಾಳಿನಗೀತೆ : ಕುವೆಂಪು	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.
ಘಟಕ-4 ತಾಂತ್ರಿಕವ್ಯಕ್ತಿಗಳಪರಿಚಯ	
1. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿಮತ್ತುಐತಿಹ್ಯ - ಎಎನ್ಮೂರ್ತಿರಾವ್ 2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.
ಘಟಕ -5 ಕಥೆಮತ್ತುಪ್ರವಾಸಕಥನ	
1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ 2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ	
ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

26.09.2022

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು **(course Outcomes):**

1. ಕನ್ನಡಭಾಷೆ, ಸಾಹಿತ್ಯಮತ್ತುಕನ್ನಡದಸಂಸ್ಕೃತಿಯಪರಿಚಯವಾಗುತ್ತದೆ.
2. ಕನ್ನಡಸಾಹಿತ್ಯದಆಧುನಿಕಪೂರ್ವಮತ್ತುಆಧುನಿಕಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯಬಗ್ಗೆಆಸಕ್ತಿಯುಮೂಡುತ್ತದೆ.
3. ತಾಂತ್ರಿಕವ್ಯಕ್ತಿಗಳಪರಿಚಯವಾಗುತ್ತದೆ.
4. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

ಮೌಲ್ಯಮಾಪನದ ವಿಧಾನ**(Assessment Details- both CIE and SEE) :**

(methods of CIE - MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and 35% marks in SEE to pass. Theory Semester End Exam (SEE) is conducted for 50 marks (01 hour duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯು ಈ ಕೆಳಗಿನಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

1. The question paper will have 50 questions. Each question is set for 01 mark.

SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

ಪಠ್ಯಪುಸ್ತಕ :

ಸಾಂಸ್ಕೃತಿಕಕನ್ನಡ

ಡಾ. ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯಮತ್ತುಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ,

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯತಾಂತ್ರಿಕವಿಶ್ವವಿದ್ಯಾಲಯ,ಬೆಳಗಾವಿ.

26.09.2022

BE- III/ IV Semester – Common to All

ಬಳಕೆ ಕನ್ನಡ - baLake Kannada (Kannada for Usage)

ಕನ್ನಡ ಕಲಿಕೆಗಾಗಿ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ - (Prescribed Textbook to Learn Kannada)

ವಿಷಯಸಂಕೇತ(Course Code)	21KBK37/47	ನಿರಂತರಆಂತರಿಕಮೌಲ್ಯಮಾಪನದಅಂಕಗಳು(Continuous Internal Evaluation Marks)	50
ಒಂದುವಾರಕ್ಕೆಬೋಧನಾಅವಧಿ (Teaching Hours / Week (L:T:P: S)	0:2:0:1	ಸೆಮಿಸ್ಟರ್ಅಂತ್ಯದಪರೀಕ್ಷೆಯಅಂಕಗಳು(Semester End Examination Marks)	50
ಒಟ್ಟುಬೋಧನಾಅವಧಿ Total Hours of Pedagogy	25ಗಂಟೆಗಳು	ಒಟ್ಟುಅಂಕಗಳು (Total Marks)	100
ಕ್ರೆಡಿಟ್ಸ್ (Credits)	01	ಪರೀಕ್ಷೆಯಅವಧಿ (Exam Hours)	01 ಗಂಟೆ

ಬಳಕೆಕನ್ನಡಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು(Course Learning Objectives):

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವ್ಯವಸ್ಥೆ (Teaching-Learning Process - General Instructions) :

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕವನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
1. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣ ಗೊಂಡಿರುವ ಭಾಷೆಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನುಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮಕ್ಕೆಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
2. ಭಾಷಾಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Module-1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - **Personal Pronouns, Possessive Forms, Interrogative words**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

26.09.2022

Module-2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕನಾಮಪದಗಳು- **Possessive forms of nouns, dubitive question and Relative nouns**
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು **Qualitative, Quantitative and Colour Adjectives, Numerals**
3. **ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

Module-3

1. **ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals**
4. **ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers**
5. **ನ್ಯೂನ / ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು Defective / Negative Verbs and Colour Adjectives**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

Module-4

1 ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತು ಒತ್ತಾಯ ಆರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು
Permission, Commands, encouraging and Urging words (Imperative words and sentences)

2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು
Accusative Cases and Potential Forms used in General Communication

3. "ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು - Helping Verbs "iru and iralla", Corresponding Future and Negation Verbs
6. ಹೋಲಿಕೆ (ತರತಮ) , ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು
ನಿಷೇಧಾರ್ಥಕಪದಗಳಬಳಕೆ- Comparitive, Relationship, Identification and Negation Words

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

Module-5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು - ifferent types of forms of Tense, Time and Verbs
2. ದ್, -ತ್, - ತು, - ಇತು, - ಆಗಿ, - ಅಲ್ಲ, - ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತುವರ್ತಮಾನಕಾಲ ವಾಕ್ಯರಚನೆ - Formation of Past, Future and Present Tense Sentences with Verb Forms
3. **Kannada Vocabulary List :**ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು- **Kannada Words in Conversation**

ಬೋಧನೆ ಮತ್ತು ಕಲಿಕಾ ವಿಧಾನ	ಪುಸ್ತಕ ಆಧಾರಿತ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನ, ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್ ಗಳನ್ನು ಬಳಸುವುದು, ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ವಿಡಿಯೋಗಳನ್ನುಬಳಸುವುದು, ವಿದ್ಯಾರ್ಥಿಗಳೊಂದಿಗೆಚಟುವಟಿಕೆಗಳಮುಖಾಂತರಚರ್ಚಿಸುವುದು.

26.09.2022

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: **course Outcomes (Course Skill** Set): At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with kannada speakers.
5. To speak in polite conservation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

ಸೆಮಿಸ್ಟರ್ ಅಂತ್ಯದ ಪರೀಕ್ಷೆಯು ಈ ಕೆಳಗಿನಂತಿರುತ್ತದೆ - **Semester End Exam (SEE):**

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

2. The question paper will have 50 questions. Each question is set for 01 mark.
3. SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

Textbook :

ಬಳಕೆಕನ್ನಡ

ಲೇಖಕರು : ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯತಾಂತ್ರಿಕವಿಶ್ವವಿದ್ಯಾಲಯ,ಬೆಳಗಾವಿ.

Samskrutika Kannada Balake Kannada OR Constitution of India, Professional Ethics			
Course Code	21KSK37/21KBK37/21CIP37	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

AEC-Ability Enhancement Courses-III Rural Development			
Course Code	**21AU381**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

6. To provide the students the flavour of basics of rural development
7. To motivate students to contribute towards rural development

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Introduction to Rural Development: Concept of Rural Development- meaning and definition, Scope and Importance of Rural Development, Approaches of Rural Development, Need of Rural Development.	
Teaching-Learning Process	• Conventional classroom teaching using chalk & talk, PPTs, Videos Experiential learning through field visits
Module-2	

26.09.2022

Rural Development Planning and Management: Rural Development Planning –District Rural Development Agency (DRDA)- Organisation Structure, Functions of DRDA, NGO's and Rural Development, Self Help Groups (SHG's) formation.	
Teaching-Learning Process	. • Conventional classroom teaching using chalk & talk, PPTs, Videos Experiential learning through field visits
Module-3	
Agriculture Enterprise & Agro-based industries: Agricultural Entrepreneur- Meaning, Definition and Importance, Agri-business Enterprises-Issues and prospectus	
Teaching-Learning Process	• Conventional classroom teaching using chalk & talk, PPTs, Videos Experiential learning through field visits
Module-4	
Micro-financing, Food and Agricultural Marketing and Management of agro-products, Agro-based industries.	
Teaching-Learning Process	• Conventional classroom teaching using chalk & talk, PPTs, Videos Experiential learning through field visits
Module-5	
Rural Development and Internet, Information & Communication Technology (ICT) for Rural Development, IT –Enable Services for an e-village, Challenges of Rural Development	
Teaching-Learning Process	• Conventional classroom teaching using chalk & talk, PPTs, Videos Experiential learning through field visits
Course outcome (Course Skill Set) At the end of the course the student will be able to: 1. Explain the need/significance of rural development and prepare rural development plans 2. Implement development plans in rural agro-based industries 3. Make use of ICT in the rural development 4. Demonstrate the significance of rural development to rural people	

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books:

2. Fundamentals of rural development, Dr. Mangesh Wagmore, Dr. S. G. Walke, Thakur Publications Pvt. Ltd., Pune.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=1_w2gDpemcc
2. https://www.youtube.com/watch?v=lcQWQWf5XiU
3. https://www.youtube.com/watch?v=R6qvm0AgWRQ
4. https://www.youtube.com/watch?v=QVWhnJP4rcU

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

4. Students should visit nearby rural areas to study the present situation.
5. Identify such practices which will improve the standard of living, income of rural folks and prepare action plan for the same.
6. Organize awareness camps in rural areas on use of information and communication tools.
7. Experiential learning through field visits
8.

AEC-Ability Enhancement Courses-III Bharat Stages (BS) of Emission Standards			
Course Code	**21AU382**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

To understand the INDIA BHARAT STAGE EMISSION STANDARDS and apply the higher engineering skills acquired to minimize the vehicle pollution

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Effect of Air Pollution: Effect of air pollution on Human Health, Effect of air pollution on animals, Effect of air pollution on plants and global warming.,Contribution of ice vehicles to atmospheric pollution,

Teaching-Learning Process	Conventional classroom teaching using teaching aids such as PPTs, group discussions

Module-2

Mechanism of pollutant formation in Engines:
Nitrogen Oxides: Formation of nitrogen oxides, formation of NO_2, NO formation in spark ignition engines, NOx formation, in compression ignition engines.
Carbon Monoxide: Formation of carbon monoxide in SI and CI Engines.

Teaching-Learning Process	. Conventional classroom teaching using teaching aids such as PPTs, group discussions

Module-3

26.09.2022

Unburned Hydrocarbons: Back ground, flame quenching and oxidation fundamentals, HC emissions from spark ignition engines, HC emission mechanisms in diesel engines. **Particulate emissions:** Spark ignition engine particulates, characteristics of diesel particulates, soot formation fundamentals, soot oxidation, crankcase emissions.India	
Teaching-Learning Process	Conventional classroom teaching using teaching aids such as PPTs, group discussions
Module-4	
Bharat stage I&II emission standards , India Bharat stage III emission standards , Data comparison and analysis, Depict the data on an excel sheet and analyse the changes over each stage	
Teaching-Learning Process	Conventional classroom teaching using teaching aids such as PPTs, group discussions , Plot on excel sheet for data analysis
Module-5	
India Bharat stage IV emission standards , India Bharat stage V emission standards , India Bharat stage VI emission standards, Data comparison and analysis, Depict the data on an excel sheet and analyse the changes over each stage	
Teaching-Learning Process	Conventional classroom teaching using teaching aids such as PPTs, group discussions , Plot on excel sheet for data analysis

Course outcome (Course Skill Set)

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

1. Understand the essence of pollution control in Indian Context
2. Analyze the various stages of BS emission and explore the possibility of limit the pollution levels further
3. Apply the engineering knowledge acquired to provide the solution to reduce the pollution from ICE vehicles.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books:

1 Automobiles and pollution Paul Dagobert (SAE) , 2001

2 Internal combustion enginefundamentals , John B. Heywood McGraw Hill Book, publication, 1998.

Web links and Video Lectures (e-Resources):

1. . https://www.araiindia.com/pdf/Indian_Emission_Regulation_Booklet.pdf
2. https://www.youtube.com/watch?v=PSIqPK-k17Y

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Conduct emission testing of 2 and 4 wheeled vehicles and compare the emission levels visa-vis Bharat V and VI standards, draw conclusion
2. Visit nearby emission testing center , interact and learn the testing procedure for petrol and diesel vehicles

26.09.2022

AEC-Ability Enhancement Courses-III Additive Manufacturing			
Course Code	**21AU383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

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

1. Basics of Additive manufacturing
2. Slicing methods and STL files
3. Types of Apparatus and Sub-systems used in Additive Manufacturing methods

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Introduction to Additive Manufacturing, CAD Models for Additive Manufacturing-Deviation Tolerance, Angle tolerance Manipulation of STL Files-STL-Rotation, support structure, Optimal orientation	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Interactive session

Module-2	
Slicing Methods-Classification, Uniform Slicing of STL files, Adoptive Slicing of STL files, Toolpath Planning, Introduction to Liquid AM-Introduction, Classification, Photo-Polymerization	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, you -tube video Interactive session

Module-3	
Stereolithography Apparatus-Sub Systems, Laser Beam, Laser Curing Mechanism, Fundamentals of Photopolymerization, SLA apparatus-Recoating, Elevating, Sweeping.	
Teaching-Learning	Chalk and talk method, Power Point Presentation, you -tube video Interactive session

26.09.2022

Process	
Module-4	
Sheet Additive Manufacturing-Cubic Technologies, Solidimentation plastic sheet lamination. Wire Additive Manufacturing-Classification, Fused Deposition Modelling-Type of Mechanisms	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation,Interactive session, you -tube video
Module-5	
Metal Wire Additive Manufacturing-History, Classification, Shape Deposition Manufacturing. Metal Inert Gas-Wire Arc Additive Manufacturing, Electron beam-based Wire Beam Additive Manufacturing (WBAM)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation,Interactive session, you -tube video

Course outcome (Course Skill Set)

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

1. Know and understand the basics of Additive manufacturing
2. Comprehend the various Slicing methods and various Stereolithographic methods
3. Identify and understand the types of Apparatus and Sub-systems used in Additive Manufacturing methods

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

7. First test at the end of 5th week of the semester
8. Second test at the end of the 10th week of the semester
9. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

5. First assignment at the end of 4th week of the semester
6. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by IonGibson,2nd edition, Springer
2. Additive Manufacturing Technologies and Applications by Salvatore Brischetto, MDPI publishers,2017

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112103306
2. https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

9. https://www.twi-global.com/technical-knowledge/faqs/what-is-additive-manufacturing
10. https://markforged.com/resources/learn/design-for-additive-manufacturing-metals

26.09.2022

AEC-Ability Enhancement Courses-III Clay modelling			
Course Code	**21AU384**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

1. To introduce the students to the methods of Clay modelling techniques.
2. To provide the students with theoretical aspects of clay modelling
3. To train students to create clay models of automobile by using the clay and modelling tools.

Sl.NO	Experiments
1	Introduction to clay modelling.
2	Different types of clay materials and their properties used for modelling.
3	Different tools required for clay modelling.
4	Mould making.
5	Clay preparation.
6	Creating simple 3D forms with clay
7	Creation of simple 3D automobile shapes (body shape)
	Demonstration Experiments (For CIE)
8	Basics of dynamic forms.Methods of clay modelling
9	Visit to fine arts school to get hands on experience , Watch https://www.youtube.com/watch?v=j_xN30_4q1U and try to replicate using clay Methods of clay modelling
10	Express visual ideas through making drawings and creating a three-dimensional clay models.
11	Use imagination and invention to represent form, texture, and detail in a clay sculpture

Course outcomes (Course Skill Set):

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

4. Prepare clay material for creating simple 3D forms
5. Prepare simple 3D forms by using clay modelling tools and techniques
6. Create 3D automobile body shapes and other simple show piece models.

.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

26.09.2022

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours Rubrics suggested in Annexure-II of Regulation book
Suggested Learning Resources: Books 1. Clay Modelling for Beginners: An Essential Guide to Getting Started in the Art of Sculpting Clay ~ (Clay Modelling | Clay Modeling | Clay Art) - by Jeanie Hirsch- 2. The Indian Technique of Clay Modelling- Motilal Banarsidass Publishers -1970 Web links and Video Lectures (e-Resources): 1. .https://www.youtube.com/watch?v=1n7apcgQiz0 2. https://www.youtube.com/watch?v=AFKnG-vENUw 3. https://www.youtube.com/watch?v=CDPlLhfvxPg

26.09.2022

4th- Semester

26.09.2022

26.09.2022

26.09.2022

IPCC- Mechanical Measurement and Metrology			
Course Code	**21AU42**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

1. Expound the significance of mechanical measurements, elements of a generalized measuring system, theory and working principle of measuring instruments for the measurement of force, torque, flow, temperature, pressure, and strain
2. Define Metrology, appreciate the objectives of Metrology, and explain the importance of standards.
3. Interpret the limits specified, identify fits and explain the concept of tolerance
4. Use comparators, screw and gear metrology

26.09.2022

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various measurement systems
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1- 8 HOURS	
Measurements, Measurement Systems and Standards of Measurement: Definition, significance of measurement, generalized measurement system, definition and concept of accuracy, precision, sensitivity, Calibration, threshold, hysteresis, repeatability, linearity, loading effect, system response, time delay, errors classification in measurement. **Characteristics of Measurement Systems:** Review of Basic Fourier Series and its implementation to signal transformations, understanding of systems subjected to step, ramp, impulse and sinusoidal signals. **Transducers, Intermediate Modifying and Display Devices**: Primary and secondary transducers, Mechanical, electrical transducers (resistive capacitive and piezoelectric transducers.)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 1-5, Exp 10)
MODULE-2- 8 HOURS	
Definition and objectives of metrology, Standard of length-International prototype meter, Imperial standard yard, Wave length standard, Subdivision of standards, line and end standard, comparison, Transfer from line standard to end standard, calibration of end bars (Numerical) **System of Limits, Fits, Tolerance and essence of Gauging**: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of	
Teaching-Learning Process	. Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 11,13)
MODULE-3 8 HOURS	
Comparators: Introduction to Comparator and its Classification, dial indicators, optical comparators, Zeiss ultra-optimeter, Electric and electronic comparators –principles, LVDT, pneumatic comparators, solex comparators **Angular Measurements and Interferometer**: Bevel protractor. Sine principle, use of sine bars, sine centre, angle gauges (numerical on building of angles), Clinometers. Principle of interferometry, autocollimator, optical flats	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 6,7,12)
MODULE-4 - 8 HOURS	

26.09.2022

Measurement of Force, Torque, Displacement, Velocity and strain: Principle, analytical balance, Piezo type force transducer – Principle, Strain-based force transducer – principle, torque measurement (for driveline shaft), types of dynamometers, Eddy current dynamometer, Laser Pickup for displacement measurement, Particle image velocimetry for velocity measurement, Preparation and mounting of strain gauges, Methods of strain measurement **Flow measuring devices** – turbine meter, electromagnetic and ultrasonic flow meter	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 8, Exp 14)
MODULE 5- 8 HOURS	
Pressure and Temperature Measurement: Principle, use of elastic members, bridge man gauge, Mcleod gauge, thermal conductivity gauge, (Pirani gauge and thermocouple vacuum gauge) ionization gauge, Resistance thermometers, thermocouple, law of thermocouple, thermocouple circuits, thermocouple materials, pyrometers, optical pyrometer. **Advanced metrology:** Inherent problems with present systems, ultra-violet recorders, Universal measuring machine (UMM) and Coordinate measuring machine (CMM), Feature measurement using CMM, Laser vision	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 9)

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Calibration of Thermocouple
2	Calibration of LVDT,
3	Calibration of Load cell
4	Measurement of Cylindricity and Circularity of Automobile Components
5	Measurement of Straightness and Flatness
6	Measurement of Angle using Sine Center / Sine bar / bevel protractor
7	Measurements using Optical Projector / Toolmaker Microscope , Measurement using Optical Flat
8	1. Determination of modulus of elasticity of a mild steel specimen using Strain gauges. 2. Speed measurement-using Stroboscope
9	Calibration of Pressure Gauge (Bourdon tube pressure gauge)

10	Demo experiments for CIE : Display of various signals through programming software
11	Demo experiments for CIE: Practical demonstration of tolerances , Measurement of gear tooth profile using Gear Tooth Vernier/Gear Tooth Micrometer
12	Demo experiments for CIE: Measurements of Surface roughness using Tally Surf/Mechanical Comparator,
13	Demo experiments for CIECalibration of Bore gauge, inside Micrometer and component measurement, Calibration of Micrometer, Vernier caliper, Height gauge using slip gauges,
14	Demo experiments for CIE ; Usage of accelerometer

Course outcome (Course Skill Set)

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

1. Explain significance of mechanical measurements, elements of a generalized measuring system, theory and working principle of measuring instruments for the measurement of force, torque, flow, temperature, pressure and strain
2. Define Metrology, appreciate the objectives of Metrology, and explain the importance of standards.
3. Interpret the limits specified, identify fits, and explain the concept of tolerance.
4. Use comparators, screw, and gear metrology

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks.

Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

4. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally scaled down to 50marks**
5. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
6. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1.Engineering Metrology. R. K. Jain Khanna Publishers, New Delhi 2007
2.Mechanical Measurements and Control D. S. Kumar Metropolitan Book Co. Pvt. Ltd, New Delhi 2005
3.Hand book of Industrial Metrology ASTME PHI 4th edition
4. Engineering Metrology K. J. Hume Kalyani publishers Third (metric) Edition

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=8DTt-f6wQxE
2. https://www.youtube.com/watch?v=HpIEeBtJupY
3. https://www.slideshare.net/taruian/introduction-to-mechanical-measurements-and-metrology
4. https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
5. https://nptel.ac.in/courses/112106179
6. https://nptel.ac.in/courses/112105048
7. https://www.youtube.com/watch?v=YmSvQe2FDKs

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/mmsynergy/labs/exp1/index.html
2. https://cgpit-bardoli.edu.in/mechanical-measurement-and-metrology-mmm-lab/

IPCC- Fluid Mechanics and Fluid Machines

Course Code	**21AU43**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-2-0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

8. Define fluid properties; describe Pascal's law, Hydrostatic law.
9. Calculate total pressure given point and between sections of pipe, Buoyancy and Stability of floating objects.
10. Apply Bernoulli's principle to solve fluid flow problems.
11. Make dimensional analysis of fluid mechanics problems.
12. Analyze various forces acting on submerged bodies

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-18 HOURS

Properties of fluids: Introduction, Properties of fluids, properties of solid, liquid and gaseous fuels, viscosity, thermodynamic properties, surface tension, Capillarity, vapor pressure and cavitation.

Fluid Statics:

Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, concept of absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

Teaching-Learning	Chalk and talk method, Power Point Presentation

26.09.2022

Process	Experiential learning through laboratory sessions : (Exp 1-5,9-10)
MODULE-28 HOURS	
Buoyancy: Buoyancy, center of buoyancy, meta centre and meta-centric height, conditions of equilibrium of Floating and submerged bodies, determination of Meta-centric height experimentally and theoretically. **Fluid Kinematics**: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), Velocity and acceleration, velocity potential function and stream function.	
Teaching-Learning Process	First topic –Chalk and talk, Second topic -- Kinematics - video/animation /Power point Presentation are used, and other numerical can be solved with chalk and talk method. Experiential learning through laboratory sessions : (Exp 11)
MODULE-3	8 HOURS
Fluid dynamics: Introduction, equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and from Euler's equation, limitations of Bernoulli's equation. **Fluid Flow Measurements:** Venturi meter, orifice meter, pitot-tube, vertical orifice, V-Notch, and rectangular notches.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation Experiential learning through laboratory sessions : (Exp 6)
MODULE-48 HOURS	
Flow through pipes: Minor losses through pipes. Darcey's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL. **Laminar flow and viscous effects:** Reynolds's number, critical Reynolds's number, laminar flow through Circular pipe-Hagen Poiseuille's equation, laminar flow between parallel and stationary plates. Definition of displacement momentum, energy	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation Experiential learning through laboratory sessions : (Exp 7)
MODULE 58 HOURS	
Dimensional analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham π theorem, dimensionless numbers, similitude, types of similitude. **Centrifugal pumps, air compressors and blowers** Centrifugal pump terminology, working, Operation of a single stage reciprocating compressor, work input through P-V diagram, steady state and steady flow analysis, efficiencies, minimum work for compression, multistage compressor, working of a blower, simple numerical	
Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation and interaction between the teaching staff and the student. Experiential learning through laboratory sessions : (Exp 8)

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

26.09.2022

Sl.NO	Experiments
1	Determination of flash and fire point of fuels.
2	Determination of calorific value of solid, liquid and gaseous fuel.
3	Determination of viscosity of oils using Torsion viscometer.
4	Determination of viscosity of oils using redwood, viscometer.
5	Determination of viscosity of oils using Saybolt viscometer.
6	Determination of coefficient of discharge of venturi meter and orifice meter V-Notch and rectangular notches.
7	Determination of major and minor losses in pipe flow (sudden enlargement, contraction, bend, entry and exit).
8	Performance testing of fluid pumps (Centrifugal, reciprocating and gear pumps). Performance testing of air blowers.
9	Demo experiments for CIE.- Determination of carbon residue and moisture content in a fuel.
10	Demo experiments for CIE- Determination of cloud and pour point of oils.
11	Demo experiments for CIE- Flow visualization in a wind tunnel / using a directed fan

Course outcome (Course Skill Set)

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

1. Understand the properties of fluids, basic principles, laws and concepts of fluid mechanics and fluid machineries like pumps and compressors.
2. Analyze the fluid flow problems concerning to pressure, force, flow measurement, buoyancy and stability, dimensionless parameters, and fluid machineries.
3. Apply the fluid kinetics and dynamics principles to solve fluid flow problems.
4. Design and compare the various instruments propelled by fluid machines

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally scaled down to 50 marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. **Marks secured will be scaled down to 50.**

Suggested Learning Resources:

Books

1. Fluid Mechanics Piyush. K. Kundu ELSEVIER 3rd Ed. 2005.
2. Fluid Mechanics Bansal, R. K. Lakshmi Publications 2004.
3. Fluid Mechanics and hydraulics Dr. Jagadishlal, Metropolitan Book Co-Ltd. 1997
4. Fluid Mechanics (SI Units) Yunus A. Cengel John M.Cimbala TMH 2006.
5. Fluid Mechanics and Fluid Power Engineering Kumar. D. S. Kataria and Sons 2004

Web links and Video Lectures (e-Resources):

1. http://elearning.vtu.ac.in/econtent/index.php#
2. http://nptel.vtu.ac.in/econtent/courses/CV/15CV33/index.php
3. https://www.youtube.com/watch?v=PgKsr2_-oxc
4. http://nptel.vtu.ac.in/econtent/Web/CV/15CV33/index.php
5. https://backbencher.club/fluid-mechanics/
6. https://www.youtube.com/watch?v=2yFgWu73hzo

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Virtual Lab link- http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/fluid_mechanics/index.php
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/fluid_mechanic_13082019/labs/index.php

PCC -Theory of Machines			
Course Code	**21AU44**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Define and explain the basic terms associated with the kinematics of machinery
2. Determine the velocity and acceleration of links using graphical methods.
3. Define gear terminology and determine the velocity ratio in different gear trains.
4. Calculate static and dynamic forces at various points in different types of mechanisms.

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Arrange visits to manufacturing units of various mechanisms and machines to give brief information about the role of mechanisms in existing systems.
3. Show Video/animation films to explain the functioning of various mechanisms
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.

9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the= students' understanding. 10. Individual teachers can devise innovative pedagogy to improve teaching-learning.
Module-1
Introduction, kinematic chains, inversions & mechanisms: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine. Inversions of Four bar chains; Single slider crank chain and Double slider crank chain. **Velocity and acceleration analysis of mechanisms:** Velocity and acceleration graphical analysis of Four Bar mechanism, slider-crank mechanism: Relative velocity and acceleration of particles in a shared link, Angular velocity and angular acceleration of links, the velocity of rubbing. Definition.
Teaching-Learning Process: Chalk and talk method, Power Point Presentation
Module-2
Gears & Gear Trains: Gear terminology, Law of gearing, Characteristics of involute action, Path of contact, Arc of contact, Contact ratio of Spur & Helical gears, Interference in involute gears. Methods of avoiding interference, Back lash,Types of Gear trains, velocity ratio, Train value, tabular methods of finding velocity ratio of epicyclic gear trains. **Cams:**Classification of cams, Types of followers, Cam nomenclature, Follower motions and motion analysis, of SHM, Motion with uniform acceleration and deceleration, uniform velocity, Cam profile with offset knife-
Teaching-Learning Process: Topic 1: Introduction and applications using power point. Derivations and numerical problems using chalk and talk method. Derivations could be given the previous day to enhance the understanding and recalling capability of the students Topic 2: introduction and applications using PowerPoint Position, velocity and acceleration analysis using chalk and talk
Module-3
Static Force Analysis: Introduction, Static equilibrium, Equilibrium of two forces, three force and four force members, Members with two forces and torque, Free body diagrams, Static force analysis (graphical) of four-bar mechanism slider-crank mechanism without and without friction. **Dynamic/Inertia Force Analysis:** Introduction, D'Alembert's principle, Inertia force, inertia torque, dynamically equivalent systems, correction couple, line of action of inertia force in a link, inertia force analysis (graphical) of a four-bar mechanism, inertia force analysis (analytical) of slider-crank mechanism [(i) neglecting the mass of the connecting rod; (ii) considering the mass of the connecting rod]
Teaching-Learning Process: Topic 1: Chalk and talk Topic 2: Chalk and talk Power points could be used for both topics. However, chalk and talk would be a more viable solution for this module
Module-4
Flywheel: Introduction, Turning moment diagrams, Fluctuation of Energy and speed, energy stored in a flywheel, determination of size of flywheels. **Governors:** Introduction, Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, condition for stability, sensitiveness, isochronism, hunting, effort, and governor power.
Teaching-Learning Process: Topic 1: General introduction with applications using power point and online videos. Fluctuation and energy intro using power point, rest using chalk & talk Topic 2: Intro and parameter of governors using PowerPoint. Rest using chalk & talk
Module-5
Friction: Types friction, the law of friction, force analysis of the sliding body, screw friction, screw jack, flat pivot bearing, flat collar bearing.

26.09.2022

Belt and Chain drive: Types of belts and chains, flat belts; angular velocity, the law of belting, length of open and cross belts, centrifugal tension, condition for maximum power. V-belts, the ratio of tensions, chain drives, chain pits and chain length.

Teaching-Learning Process	Topic 1 & 2: Introduction using power point. Demo of belt and chain drives specifically using actual models. The rest of the module uses chalk and talk

Course outcome (Course Skill Set)

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

1. Define and explain the basic terms such as kinematic chain, kinematic pair, degree of freedom etc., associated with the kinematics of machinery, inversions of four-bar mechanism, single slider crank mechanism and double slider-crank mechanism.
2. Determine the mobility of given mechanisms.
3. Determine the velocity and acceleration of links using graphical methods.
4. Plot cam profiles using displacement diagrams for various types of motions.
5. Calculate static and dynamic forces at various points in different types of mechanism flywheel dimensions.
6. Find the controlling force in various governors.
7. Describe the fluctuation of energy in flywheel, various types of governors, and understand the method of finding.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored will be proportionally scaled down to 50 marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books:

Textbook/s

1. Theory of Machines Rattan S. S. Tata McGraw Hill, Publishing Company Ltd 2012
2. Theory of Machines Sadhu Singh Pearson Publications, New Delhi 2000

Reference Books

1. Theory of Machines and Mechanisms, Joseph E. Shigley, Jr. Uicker John, McGraw Hill publications, 1998
2. Dynamics of Machinery A. R. Holowenko, John Wiley & sons. 2000
3. Theory of Machines R. S. Khurmi and J. K. Gupt S. Chand and Co 2015

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112106270
2. https://www.youtube.com/watch?v=QSUOsQokxS8

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

11. https://mm-nitk.vlabs.ac.in/List%20of%20experiments.html

AEC- Biology for Engineers			
Course Code	21BE45	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	2	Exam Hours	2

PCCL- Computer Aided Machine Drawing			
Course Code	21AUL46	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0-0-2-0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Use tools of drafting and modelling software
- Draw the sections of solids, orthographic views of simple machine parts using software,
- Sketch and explain various thread forms and their application.
- Calculate parameters related to riveted joints and sketch them.
- Create solid models and draw the sectional views of automotive systems..

Sl.NO	PART -A
1	Introduction: Review of graphic interface of the software. Basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap. Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections. Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.
2	Thread forms: Thread terminology, forms of threads – BSW Thread, Sellers thread, ISO Metric thread, square and Acme thread. Conventional representation of threads. Fasteners: Hexagonal headed bolt and nut with washer (assembly), square-headed bolt and nut with washer (assembly). Types of Bolt heads, special types of nuts, locking of nuts, Studs, set screws, grub screws.
	PART -B
3	Keys, cotter and knuckle joints: Types of Keys, Cotter and knuckle Joints Riveted Joints: lap joints- single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).

26.09.2022

4	Automotive components: Spark plug, IC Engine valve, Rocker arm, Cylinder liner, Stub-axle, Oldham's coupling and universal coupling (Hooks' Joint) Couplings: Split Muff coupling, Protected type flanged coupling.
	PART -C
5	Assembly drawing of following machine parts (3D parts to be created and assembled and then getting 2D drawing with required views, along with 3D part drawings). 1. Plummer block (Pedestal Bearing) 2. Petrol Engine piston 3. I.C. Engine connecting rod 4. Screw Jack 5. Single cylinder crank shaft
	Demonstration (For CIE)
6	Read the Industry drawing of automobile components and assemblies (At least two) as decided by the concerned faculty

Course outcomes (Course Skill Set):

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

1. Use tools of drafting and modeling software
2. Draw the sections of solids, orthographic views of simple machine parts using software
3. Sketch various thread forms, different types of joints and fasteners and explain their application.
4. Prepare assembly drawing from the list of components and read / interpret standard industry drawings.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE). Out of total of CIE and SEE the student has to score 40% of maximum marks (40 out of 100 Marks)

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for sketch book/ record/ journal and test are in the ratio **60:40**.

- Each Drawing Session to be evaluated for conduction with observation sheet and record write-up/sketch book. . Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Sketch book/ Record should contain all the specified drawings covered in the syllabus and each drawing session /sketch and print outshall be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of /sketch book/record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All drawings are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Important Note:

- **SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) as per the following:**
- **Two questions to be set from each Part. Student has to answer one question from each Part.**

PART-A: 1x20 = 20Marks
PART-B: 1x20 = 20Marks
PART-C: 1x60 = 60 Marks

The duration of SEE is 03 hours

Evaluation of test write-up/ conduction procedure/sketching and result/viva /Final printout of sketch will be conducted jointly by examiners.

Suggested Learning Resources:

Books

1. Engineering Drawing and Design, David A. Madsen, David P. Madsen · Cengage Learning, 2012,
2. Machine Drawing K. R. Gopala Krishna ,Subhash Publication.
3. A Primer on Computer Aided Machine Drawing Published by VTU
4. 3 A Text Book of Computer Aided Machine Drawing S. Trymbaka Murthy CBS Publishers, New Delhi 2007
5. 4 Machine Drawing with Auto CAD Goutam Purohit & Goutham Ghosh 1st Indian print Pearson Education, 2005
6. 5 Machine Drawing N. Siddeshwar, P. Kanniah, V. V. S. Sastri Tata McGrawHill, 2006

Suggested Learning E-Resources:

1. https://www.wikihow.com/Read-Engineering-Drawings

AEC-Ability Enhancement Courses-IV
Theory and Applications of Sensors and Actuators

Course Code	**21AU481**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

1. To introduce the concepts of sensors and actuators highlighting its principles
2. To understand the basics of signal processing
3. To provide hands on experience on the usage of sensors and actuators using open source platforms

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.

2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various sensors and actuators
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Introduction to Sensors and Actuators: Mechanics & requirement of sensor, sensor specifications; experimental error analysis; measurement uncertainty, signal conditioning, Introduction to actuators and its control.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session) 1. Hands-on experience with low-cost sensors and actuators with motor driver circuits 2. Importance of measurement using examples 3. Display of various signals through programming software
Module-2	
Fundamentals of Signal processing: Introduction to DSP, History and Applications; Sinusoids, Frequencies and Spectral Representations, Periodic Signals, Fourier Series, Sampling, Sampling Rate Conversions, Aliasing, Digital Filters	
Teaching-Learning Process	1. Showcasing various aliasing techniques using programs 2. Importance of sampling using Nyquist criterions
Module-3	
Overview of Sensors: Sensor components: Measurement of Temperature, RH, Pressure, strain, force, torque, displacement, velocity, Acceleration, rotation, and rpm – use of different sensors.	
Teaching-Learning Process	1. Use of thermocouples, strain gauges, encoders, pressure cell, load cell through actual sensors or educational videos 2. Importance of sampling of sensor data using signal processing techniques
Module-4	
Overview of Actuators: Solenoids, DC motor and its control, stepper motor and its control, servo motors PWM generation and control	
Teaching-Learning Process	1. Use of various actuators such as DC motors, and its importance with reference to requirements. 2. Importance of motor driver circuits and control of speeds
Module-5	
Mini project on Integrated Applications of Sensors and Actuators: Use of different kinds sensors along with open-source ADC board like Arduino and Raspberry PI Open-source data acquisitions	
Teaching-Learning Process	Use of low-cost data acquisition devices such as Arduino and Raspberry pi This module is specifically practical oriented where students could be given a mini project

	with specific objectives related to usage of sensors and actuators

Course outcome (Course Skill Set)

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

1. Explain significance of sensors and actuators for generalized measuring system, with the relevant theory and working principle of measuring instruments for the measurement of force, torque, flow, temperature, pressure and strain
2. Understand the basics of signal processing, and explain its importance of data acquisitions.
3. Hands on experience to students on acquiring data, filtering it and apply a signal to the actuator.
4. Usage of filters and sampling rate to the data

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Sanjay Gupta, Joseph John Virtual Instrumentation Using Lab VIEW Tata MaGraw-Hill, 2005.
2. D Patranabis, Sensors and Transducers, Phl 3nd Edition, 2013.
3. J.P. Holman Experimental Methods for Engineers McGraw-Hill, 8th Edition, 2010.
4. James H McClellan, DSP First A Multimedia Approach ,Prentice Hall International , 1999.
5. Richard Crowder, Electric Drives and Electromechanical Systems: Applications and Control Elsevier, 2010.

Web links and Video Lectures (e-Resources):

26.09.2022

1. https://www.youtube.com/watch?v=H5pUjXdyjJU
2. https://www.youtube.com/watch?v=kUHmYKWwuWs
3. https://www.youtube.com/watch?v=0qwrnUeSpYQ
4. https://www.youtube.com/watch?v=6gccSyp_uJQ

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Practical based learning

AEC-Ability Enhancement Courses-IV
Earth Moving Equipments

Course Code	**21AU482**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

1. Explain about various basic operations and applications of earth moving equipment.
2. Select under carriage, hydraulics, steering systems of tractors.
3. Select suitable machine for hauling depending on type of land, haul distance, climate, etc

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

.

Module-1

Equipment and Operation: Different types, working principles and applications of bull Dozers, Loaders, Shovels, Excavators, Scrapers, Motor graders, Rollers, Compactors, Tractors and Attachments.

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos

Module-2

Engine, Under Carriage and Suspension Systems: All systems of engine and special features like Automatic injection timer, turbochargers, after coolers etc., Tyre and tracked vehicles, under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes. Rubber spring suspension and air spring suspension.

26.09.2022

Teaching-Learning Process	. Chalk and Talk, PPT, You Tube videos

Module-3

Transmissions and Final Drives: Basic types of transmissions, auxiliary transmission, compound transmission, twin triple countershaft, transmissions and planetary, transmission, constructional and working principles, hydro shift automatic Transmission and retarders.

Final Drives:

Types of reductions like, single reduction, double reduction final drives and planetary final drives PTO shaft.

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-4

Hydraulics: Basic components of hydraulic systems like pumps (types of pumps), control valves like flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth & draft control systems.

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, PBL

Module-5

Criterion for Selection of Equipment: Selection of machines based on type of soil, haul distance, weathercondition, calculation Of Operating Capacity and calculation of productivity of a bull dozer

Earth Moving Equipment Maintenance & Safety: Types of maintenance schedules, purpose andadvantages, organization set ups, documentation. Safety methods for earth moving equipment.

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos,

Course outcome (Course Skill Set)

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

1. Explain about various basic operations and applications of earth moving equipment.
2. Select under carriage, hydraulics, steering systems of tractors.
3. Select suitable hauling machine depending on type of land, haul distance, climate, etc.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Diesel equipment Erich J.schulz , PHI , volume I and II
1. Construction equipment and its management, S. C. Sharma, McGraw Hill , 2002
2. Theory of ground vehicles J. Y. Wong , John Wiley and sons, 1999
3. On and with the earth Jagman Singh W. Newman and Co.. Kalkata , 2005

Web links and Video Lectures (e-Resources):

1. https://www.constrofacilitator.com/different-types-of-earthmoving-equipment-used-in-construction/.
2. https://www.thebalancesmb.com/must-have-earth-moving-construction-heavy-equipment-844586
3. https://www.youtube.com/watch?v=cwNq3PI5kWI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Visit to nearby EM equipment dealer and study the operation and working

26.09.2022

AEC-Ability Enhancement Courses-III Autonomous vehicles			
Course Code	**21AU483**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

This course will introduce you to the terminology, design considerations and safety assessment of self-driving vehicles. By the end of this course, student will be able to: -

1. Understand commonly used hardware used for self-driving vehicles
2. Identify the main components of the self-driving software stack - Program vehicle modelling and control
3. Analyse the safety frameworks and current industry practices for vehicle development

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Introduction to autonomous driving: autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception, Object Recognition and Tracking: Autonomous driving client system: Robot Operating System, Hardware platform: Autonomous driving cloud platform: Simulation, HD Map Production, Deep learning Model Training	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-2	
Autonomous vehicle localization: Localization with GNSS: GNSS overview, GNSS error analysis, satellite-based augmentation systems, real time kinematic and differential GPS, precise point positioning, GNSS INS integration, Localization with LiDAR and HD maps Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry; Sensor fusion	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-3

26.09.2022

Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Sterio, Optical flow and Scene flow; Deep learning in Autonomous Driving Perception:Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-4	
Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, Lane level routing: Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-5	
Decision planning and control: Behavioural decisions, Motion planning, Feedback control, Reinforcement Learning Based Planning and Control, Client systems for Autonomous Driving: Operating systems and computing platform, Cloud platform for Autonomous driving: Introduction, infrastructure, simulation	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Course outcome (Course Skill Set)

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

1. Understand the Autonomous systems and its requirements
2. Explain different aspects like algorithm, sensing, object recognition and tracking, plan and control motion of an Autonomous system
3. Do the error analysis of systems and use the tools and techniques and shall be able to do lane level routing and create simple algorithms

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Creating Autonomous Vehicle Systems . Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot Morgan & Claypool Publishers, 1st Edition, 2018
2. Autonomous Vehicles for Safer Driving, Ronald K. Jurgen, SAE International Edition, 2013

Web links and Video Lectures (e-Resources):

1. https://analyticsindiamag.com/free-online-resources-get-started-autonomous-cars/.
2. https://innovationatwork.ieee.org/autonomous-vehicles-resources/
3. https://www.wired.com/story/guide-self-driving-cars/
4. https://www.nvidia.com/en-us/self-driving-cars/
5. https://www.youtube.com/watch?v=wAaSJUAKPuY
6.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Explore related videos on the subject like https://www.youtube.com/watch?v=twMHsKYtHKA
2. Build simple VOICE CONTROLLED systems
3. Discuss the levels of autonomy, as defined by SAE

26.09.2022

AEC-Ability Enhancement Courses-III
Drive Cycles of Electric Vehicles

Course Code	**21AU484**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

1. Learn and compute the drive train requirements and vehicle performance parameters
2. Basics of vehicle dynamics and power and torque calculations
3. Concept of drive cycles and application of the same with reference to Indian Standard(IDC)

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Drive-train for a petrol vehicle, Petrol Vehicles to Electric Vehicles, Electric drive train, Engine, Motor & Controller: Force and Torque, Vehicle Speed and Power, Vehicle Performance parameters, **Infrastructure Required for Vehicles to run,EV Charging Stations,Vehicle Control Unit (or MCU),Battery Power and Range Required,Battery Energy (Capacity),Battery Power**

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-2

Vehicle Dynamics, tractive force,Aerodynamic Drag◦Rolling Resistance◦Uphill Resistance◦Acceleration, Forces acting on a vehicle in motion,Aerodynamic drag, Rolling Resistance and uphill Resistance,Typical values of Rolling Resistance, Gradient resistance,

Teaching-Learning Process	. Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

26.09.2022

Module-3	
Power required to climb, Power and Torque to accelerate, Power required for acceleration (pick-up),Average Power required for acceleration,Power for pick-up acceleration alone	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-4	
Concept of a Drive-cycle-Drive Cycle,Definition of a Drive-cycle,Standard Drive Cycle, 2-wheeler / AutoIndia Drive Cycle (IDC),Compute Distance and Energyfor the full drive-cycle,Low-end 2-wheeler,Spread-sheet for a typical 2-wheeler,Consider Regeneration Efficiency R = 0.5	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-5	
Drive Cycles and Energyused per km,E-auto, e-rickshaw and Compact Sedan, Electric Auto-E-auto: velocity, distance and acceleration,Energy per km of e-auto with R = 0.5,e-rickshaw: IDC-Energy Efficiency of e-rickshaw (R=50%),4-Wheelers: Modified Indian Drive Cycle (MIDC), Electric compact-Sedan-Compact Sedan Energy Efficiency,Low-end Electric Trucks-Delivery Truck Specs,Trucks: Modified Indian Drive Cycle (MIDC),Traction Energy used for a drive-cycle	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Course outcome (Course Skill Set)

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

1. Compute the drive train requirements and vehicle performance parameters
2. Analyze the design parameters of vehicle dynamics and apply the same to arrive at power and torque requirement of different segments of EVs
3. Understand and apply the concept of drive cycles and create Indian Drive Cycles for different segments of Electric Vehicle IDC)

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

4. First test at the end of 5th week of the semester
5. Second test at the end of the 10th week of the semester
6. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

3. First assignment at the end of 4th week of the semester
4. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. . Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, CRC Press, 2018, II Edition.
2. Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles John G. Hayes ,University College Cork, Ireland ,G. Abas Goodarzi, US Hybrid, California, USA, © 2018 John Wiley & Sons Ltd

Web links and Video Lectures (e-Resources):

1. IEEE Electrification Magazine:https://ieeexplore.ieee.org/document/8546812
2. Blog “understanding the EV Elephant”:http://electric electric-vehiclesvehicles-in -india.blogspot.com/
3. WRI-CBEEV Report: 'A Guidance Document on Accelerating Electric Mobility in India'
4. NITI Aayog Report: Zero Emission Vehicle(ZEV): Towards a policyFramework
5. NPTEL Video Course : NOC:Electric Vehicles and Renewable Energy

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Construction of IDC and MIDC for a typical 2-wheeler in a Spread-sheet
2. Construction of IDC and MIDC for a typical 4-wheeler in a Spread-sheet
3. Construction of IDC and MIDC for a typical mini -truck in a Spread-sheet

5th Semester

Heat and Mass Transfer			
Course Code	**21AU51**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Explain fundamental principles and laws of conduction, convection and radiation modes of heat transfer and mass transfer.
2. Analyze all modes of heat transfer and mass transfer under different conditions.
3. Calculate heat exchange through heat exchanger.
4. Apply laws of radiation heat transfer to solve engineering problems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introductory concepts: Modes of heat transfer: Basic laws governing conduction, convection, and radiationheat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heattransfer mechanism. Boundary conditions of 1st, 2nd and 3rd Kind,

Conduction:3- dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems. (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance, Concept of variable thermal conductivity. Numerical problems and Mathematical formulation.

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources

Module-2

Heat transfer in extended surfaces of uniform cross-sectionwithout heat generation, Long fin, and short fin with insulated tip and without insulated tip and fin connectedbetween two heat sources. Fin efficiency and effectiveness. Numerical problems.

One-dimensional Transient Conduction: Conduction in solids with negligible internal temperature gradient(Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction inslab, long cylinder and sphere; use of transient temperature charts for transient conduction in semi-infinitesolids. Numerical Problems.

Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Module-3

Free or Natural Convection: Application of dimensional analysis for free convection- physical significanceof Grashoff number; use of correlations free convection from or to vertical, horizontal and inclined flat plates,vertical and horizontal cylinders and spheres, Numerical problems.

Forced Convections: Applications of dimensional analysis for forced convection. Physical significance ofReynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically andthermally developed flows inside a duct use of correlations for flow over a flat plate, over a cylinder andsphere. Numericals.

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Module-4

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and foulingfactor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

Condensation and Boiling: Types of condensation (discussion only) Nusselt's theory for laminarcondensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontaltube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling pool boilingcorrelations, Numericals.

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Module-5

Thermal radiation: Definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law.

Radiation heat exchangebetween two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces- Numerical problems.

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Course outcome (Course Skill Set)

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

1. Explain fundamental principles and laws of conduction, convection and radiation modes of heat transfer and mass transfer.
2. Analyze all modes of heat transfer and mass transfer under different conditions.
3. Calculate heat exchange through heat exchanger.
4. Apply laws of radiation heat transfer to solve engineering problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Heat transfer P. K. Nag, Tata McGraw Hill, New Delhi, 2002.
2. Heat transfer-A basic approach Ozisik, Tata McGraw Hill, 2002.
3. Heat transfer, a practical approach, Yunus A, Cengel,Tata McGraw Hill, 2001
4. Principles of heat transfer Kreith Thomas Learning 2001 ,
5. Heat & Mass transfer Tirumaleshwar, Pearson education 2006

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112101097

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

12. Practical based learning by conducting experiments in a Heat Transfer lab and analyzing the experimental Data
13. CFD analysis of simple applications of Heat transfer problems

26.09.2022

IPCC - Fundamentals Of Electrical Vehicles			
Course Code	**21AU52**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -2 -0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- Learn and compute the drive train requirements and vehicle performance parameters
- Basics of vehicle dynamics and power and torque calculations
- Understand the battery basics of EVs and the traction control mechanisms
- Understand the concepts of fuel cell and its application as an alternate energy source

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1	8 HOURS

Vehicles and Energy Sources , Electromobility and the Environment , A Brief History of the Electric Powertrain , Energy Sources for Propulsion and Emissions , Carbon Emissions from Fuels, Greenhouse Gases and Pollutants,The Impact of NOx , Drive Cycles, EPA Drive Cycles , BEV Fuel Consumption, Range, and mpge, Carbon Emissions for Conventional and Electric Powertrains,

An Overview of Conventional, Battery, Hybrid, and Fuel Cell Electric Systems, Conventional IC Engine Vehicle , BEVs, HEVs , Series HEV , Parallel HEV, Series-Parallel HEV, FCEV , A Comparison by Efficiency of Conventional, Hybrid, Battery and Fuel Cell Vehicles,

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Experiential learning through laboratory sessions : (Exp 1-3)

MODULE-2	8 HOURS

26.09.2022

Vehicle Dynamics:

Vehicle Load Forces: Basic Power, Energy, and Speed Relationships , Aerodynamic Drag , Rolling Resistance , Vehicle Road-Load Coefficients from EPA Coast-Down Testing , Battery Electric Vehicle Range at Constant Speed , Effect of Auxiliary Loads on Range, Gradability , Simple Numericals

Vehicle Acceleration :

Regenerative Braking of the Vehicle , Traction Motor Characteristics , Acceleration of the Vehicle , Time-Step Estimation of Vehicle Speed , A Simplified Equation Set for Characterizing Acceleration by Ignoring Load Forces , Simple Drive Cycle for Vehicle Comparisons, Simple Numericals

Teaching-Learning Process	Chalk and Talk, Video and PPT Presentations, Experiential learning through laboratory sessions : (Exp 4-6)

MODULE-3	8 HOURS

Batteries

Introduction to Batteries , Batteries Types and Battery Packs, Recent EVs and Battery Chemistries , Basic Battery Operation, Basic Electrochemistry, Lead-Acid Battery , Nickel-Metal Hydride, Lithium-Ion , Units of Battery Energy Storage , Capacity Rate, Battery Parameters and Comparisons , Cell Voltage, Specific Energy , Cycle Life, Specific Power, Self-Discharge, **Lifetime** and Sizing Considerations, Examples of Battery Sizing, BEV Battery Sizing and PHEV Battery Sizing , Battery Pack Discharge Curves and Aging ,

Battery Charging,

Protection, and Management Systems , Battery Charging , Battery Failure and Protection , Battery Management System , Battery Models, A Simple Novel Curve Fit Model for BEV Batteries , Voltage, Current, Resistance, and Efficiency of Battery Pack Numerical Examples on determining the Pack Voltage Range for a BEV, A Simple Curve-Fit Model for HEV Batteries , Example: Determining the Pack Voltage Range for a HEV

Charging , Example: Fast Charging a Battery Pack, Determining the Cell/Pack Voltage for a Given Output\Input Power , Numerical Examples on Battery Discharge, Battery Charge , Cell Energy and Discharge Rate , Cell Capacity

Teaching-Learning Process	Chalk and Talk, Video and PPT Presentations, Experiential learning through laboratory sessions : (Exp 7-8)

MODULE-4 8 HOURS

Introduction to Traction Machines

Propulsion Machine Overview: DC Machines , AC Machines, Comparison of Traction Machines ; Machine Specifications - Four-Quadrant Operation, Rated Parameters ,Rated Torque, Rated and Base Speeds , Rated Power, Peak Operation , Starting Torque, Numerical Examples

Characteristic Curves of a Machine, Constant-Torque Mode , Constant-Power Mode, Maximum-Speed Mode, Efficiency Maps, Conversion Factors of Machine Factor units, Numerical Examples

Teaching-Learning Process	Chalk and Talk, Video and PPT Presentations, Experiential learning through laboratory sessions : (Exp 9-11)

MODULE 5 8 HOURS

Fuel Cells

Introduction to Fuel Cells -: Fuel Cell Vehicle Emissions and Upstream Emissions, Hydrogen Safety Factors; Basic Operation - Fuel Cell Model and Cell Voltage , Power and Efficiency of Fuel Cell and Fuel Cell Power Plant System, Fuel Cell Characteristic Curves ; Sizing the Fuel Cell Plant , Balance of Plant, Boost DC-DC Converter , Fuel Cell Combination, Fuel Economy of Fuel Cell Electric Vehicle

Conventional and Hybrid Powertrains

Introduction to HEVs, Brake Specific Fuel Consumption, Energy Consumption, Power Output, Efficiency, and BSFC

Teaching-Learning	Chalk and Talk, Video and PPT Presentations,

26.09.2022

Process	Experiential learning through laboratory sessions : (Exp 1-2, 6-8,10)

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	A Case Study Comparison of Conventional, Hybrid, Battery, and Fuel Cell Vehicles
2	A Comparison of Automotive and Other Transportation Technologies
3	Demonstration of wiring layout of electric vehicle,
4	Construction of IDC and MIDC **for a typical 2-wheeler** in a **Spread-sheet**
5	Construction of IDC and MIDC **for a typical 4-wheeler** in a **Spread-sheet**
6	Construction of IDC and MIDC **for a typical mini -truck** in a **Spread-sheet**
7	Control/ voltage control of an electric vehicle
8	Control circuit of induction motor
9	Experiment for conversion of DC to DC voltage using converter
10	Simulation for AC to DC Conversion
11	Study of 3 phase Induction motor
12	**Demo experiments for CIE**: Demonstration of layout of Fuel cell electric vehicle
13	**Demo experiments for CIE** No-Load and Load Voltages of a PEM Fuel Cell

Course outcomes (Course Skill Set):

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

1. Understand the basic requirements of an electric vehicle like dynamics, performance parameters, batteries , traction control and fuel sell as an alternative power source
2. Analyze the design parameters of vehicle dynamics and apply the same to arrive at power and torque requirement, battery/fuel cell type and requirement of different segments of EVs,
3. Apply the basics of vehicle dynamics, batteries and fuel cell to calculate the performance parameters, capacity of the cell and the traction controllers
4. Design a small battery pack and test run using a small vehicle prototype.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken

together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 Marks
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum

marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, CRC Press, 2018, II Edition.
2. Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles John G. Hayes ,University College Cork, Ireland ,G. Abas Goodarzi, US Hybrid, California, USA, © 2018 John Wiley & Sons Ltd

Web links and Video Lectures (e-Resources):

1. Introduction to Hybrid and Electric vehicles by Dr. Praveen Kumar and Prof. S. Majhi (IIT Guwahati), NPTEL Course (https://nptel.ac.in/courses/108/103/108103009/).

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Design a small battery pack and test run using a small vehicle prototype.
2. Construction of IDC and MIDC for a typical 2-wheeler/4 -wheeler and minitruck in a Spread-sheet

26.09.2022

Design of Automobile components

Course Code	**21AU53**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-0-0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Define and explain basic terms related to the design of machine elements.
2. Design various machine elements.
3. Calculate specifications of springs/gears/clutches.
4. Select a suitable size, module & type of gears for a required velocity ratio.
5. Design various internal combustion engine parts.

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby automobile component manufacturing plants and other OEMs to give brief information about the design aspects of automobile components.
3. Show Video/animation films to explain the functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the= students' understanding.
10. Individual teachers can devise innovative pedagogy to improve teaching-learning.

Module-1

Introduction: Designation and Mechanical Properties of Engineering Materials, design considerations, basic design concept (strength consideration), Failure of brittle materials, Failure of ductile materials, design of simple machine members subjected to static loading (including eccentric load) [limited to biaxial stresses].

Theories of Failure: Maximum normal stress theory, Maximum shear stress theory.

Design for fatigue strength: fatigue and endurance limit, S-N Diagram, Low & High cycle fatigue, modifying factors: load, size and surface factors, Soderberg and Goodman relationship

Teaching-Learning Process	**Topic 1:** Introduce the importance of design engineering from real-life examples such as bridges, automobiles, etc. This could be done using online videos and PowerPoint presentations. The stress-strain curves could be recalled from chalk and talk and data handbook **Topic 2& Topic 3:** Importance of various theories of failure and fatigue could be taught using chalk & talk and data handbook

Module-2

Design of Simple Machine Elements: Design of Knuckle joints. Design of keys, design of flange type of rigid coupling.

Design of Shaft: shafts subjected to combined bending and twisting, shaft design based on strength & torsional rigidity, ASME code for shaft design, Torsion in shafts, torsional moment of resistance, twist in shaft sections.

Shear forces & bending moments: Shear forces and bending moments introductions, shear forces and bending moments of cantilever beams subjected to udl,uvl and point loads

26.09.2022

Teaching-Learning Process	**Topic 1:** The importance of joints in the first place could be made to be taught using an actual joint and explaining its difference with couplings. Powerpoint presentations could also be used to highlight the same. Rest could be done with chalk & talk and data handbook **Topic 2:** The importance of a perfectly running shaft could be highlighted with the efficiency of power transmitted and further understanding of the shafts using the applications. The rest of the design could be done using chalk & talk with the data handbook **Topic 3:**A brief introduction to the shear force and bending moment diagrams could be given using the various FEM software to better visualize
Module-3	
Springs: Introduction, types of springs, terminology, stresses and deflection in helical coil springs of circular and non-circular cross-sections, springs under fluctuating loads, concentric springs. Leaf Springs: stresses in leaf springs, equalized stresses and length of spring leaves. **Clutches & Brakes:** Introduction, design of Clutches (single plate, multi-plate clutches). Brakes, energy absorbed by a brake, heat dissipated during braking, design of brake shoes.	
Teaching-Learning Process	**Topic 1:** Springs could be introduced with the requirement of the conversion of energies from the stored energy to the dissipated energy. Various parameters could be introduced with powerpoint. Rest could be taught with chalk and talk and data handbook **Topic 2:** The importance of clutches and brakes could be taught through online videos and powerpoint presentations. Further, from the applications, the importance of the recent developments in automatic transmissions and the ABS could also be introduced. Rest could be with chalk and tlk using data handbook
Module-4	
Connecting Rod: Length of the rod, Cross-section, Buckling, Drilled connecting rods, piston pin bearing, offset connecting rods, effects of whipping, bearing materials and lubrication, calculation of significant dimensions. **Crank Shaft:** Balance weights, local balance, Crankshaft proportions, oil holes drilled in crank shafts, balancing, vibration-dampers, firing order, bearings and lubrication Types of crank shafts, design of the center crank shaft, moments on crank shafts, center crank shaft at TDC, center crank shaft at an angle of maximum torque. Design of side crankshaft (over hang), side crank shaft at TDC, side crank shaft at an angle of maximum torque, calculation of significant dimensions.	
Teaching-Learning Process	**Topic 1:** Connecting rod and its role in transmission could be shown using online videos and laboratory facilities. Importance of a perfectly manufactured CR and its bending loads again could be connected with the buckling studied in mechanisms of machines. Rest could be taught using chalk and talk and data handbook **Topic 2:** Strength of the crankshaft could be highlighted using the various forces generated on the same during the up and down movement of the piston. Rest could be taught using chalk and talk with data handbook
Module-5	
Internal combustion engine components design: **Piston, Piston Rings and Piston Pin:** Piston Temperatures, piston slap, compensation of thermal expansion in pistons. Piston Rings, forms of the gap, stresses in piston rings, ring collapse, heat treatment, piston ring selection, shape: piston pin, locking of piston pins, length of the piston, calculation of major dimensions. **Valve and Valve Mechanism:** Number of valves per cylinder, Angle of the seat, operating conditions, operating temperatures, valve cooling, Sodium cooled valves, Valve rotators, valve seats, valve guides, valve springs, valve clearance, OHV, OHC, dual valves, Valve train component details, Camshaft,-drives of cams, cam types, tappets,-automatic zero clearance tappets, push rods, rocker arms & rocker Shaft, calculation of major dimensions	
Teaching-Learning Process	**Topic 1:** Designing the piston arrangement requires the assessment of the forces and stresses generated during the various cycles of the combustions. This could be first highlighted using online videos. Rest of the designing of the same could be done using chalk and talk with data handbook **Topic 2:** The importance of proper valve design could be highlighted using online videos or Powerpoint. Proper understanding is required for the valve timing, which could be done with VTD. Laboratory experiments related to valve timing diagrams could be decided. Rest could be taught using chalk and talk with data handbook

Course outcome (Course Skill Set)

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

1. Define and explain basic terms related to the design of machine elements.
2. Design various machine elements & Analyze the stresses in shafts
3. Calculate specifications of springs/gears/clutches.
4. Design connecting rods & crank shafts
5. Design various internal combustion engine parts.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

Design Data Hand Books:

1. Design Data Hand Book K. Mahadevan and K. Balaveera Reddy, CBS, Publication. 4th edition
2. Design Data Hand Book K. Lingaiah McGraw Hill, 2nd Ed. 2003.

Text books:

1. Mechanical Engineering Design Joseph E Shigley and Charles R. Mischke McGraw Hill Int. edition. 2003
2. Design of Machine Elements V. B. Bhandari Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.
3. Strength of Materials, S.S. Bhavikatti, Vikas Publications house, Pvt. Ltd. 2006

Reference Books:

1. Machine Design- Norton Robert L. Pearson Education Asia 2001.

2. Machine Design Hall, Holowenko, and Laughlin, Tata McGraw Hill Publishing Company Ltd, 2010
Web links and Video Lectures (e-Resources):
1. https://www.youtube.com/watch?v=mzWMdZZaHwI
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 14. Laboratory activities related to design laboratory

26.09.2022

Automotive Transmission			
Course Code	**21AU54**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-2-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Explain the Constructional, design and working principles of different types of clutches, fluid couplings, torque convertors, different gear box etc.
2. Determine the gear ratio, speed of vehicle and number of teeth on driving and driven gears.
3. Explain the constructional and principle of operation of different types epicyclic gear box, Calculationof gear ratio for epicyclic gear box.
4. Understand necessity, advantages, constructional and principle of operation of different types ofautomatic transmissions and hydraulic control of ICE and Electric Vehicles.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

.

Module-1

Power Required for Propulsion:

The need for transmission, Various Resistances to Motion of the Automobile, Traction, tractive effort Performance curves, acceleration gradeability, drawbar pull, Numerical Problems.

Transmission in ICE vehicles:

Necessity of gear box, Calculation of gear ratios for vehicles, Performance characteristics in different gears , Desirable speed ratios of gear boxes, Constructional details of - Sliding-mesh gear box, Constant-mesh gear box, Synchromesh gear box, auxiliary transmissions, numerical problems.

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-2

26.09.2022

Clutch:
Necessity of clutch in an automobile, requirements of a clutch, Clutch materials, clutch lining, different types of clutches, friction clutches-Single plate clutch, multi plate clutch, cone clutch, centrifugal clutch, electromagnetic clutch, hydraulic clutches, Vacuum operated clutch, Clutch adjustment, Clutch troubles and their causes, Numerical problems.

Fluid Coupling &One-way clutches:
Constructional details of various types, percentage slip, one-way clutches (Over running clutch) like sprag clutch, ball and roller one way clutches, necessity and field of application, working fluid requirements, fluid requirements, fluid requirements and fluid coupling characteristics.

Teaching-Learning Process	. Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-3

Epicyclic Transmission:
Principle of operation, types of planetary transmission, Wilson planetary transmission, Ford-T model gear box , Pre selective mechanism, Vacuum control, pneumatic control, hydraulic control in the planetary gear system, Over drives, Numerical problems.

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-4

Hydrostatic Drives:
Principles of hydrostatic drives, different systems of hydrostatic drives, constant displacement pump and constant displacement motor, variable displacement pump and constant displacement motor and variable displacement motor, variable displacement pump and variable displacement motor, applications, plunger type pump and plunger type motor, advantages and limitations, typical hydrostatic drives, hydrostatic shunt drives.

Automatic Transmission:
Principle, general description and working of representative types like Borge - warner, 4-speed and 6-speed automatic transmission longitudinally mounted four speed automatic transmission, hydramatic transmission, the fundamentals of a hydraulic control system, basic four speed hydraulic control system.

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-5

Electric Vehicle Drivetrain
EV Transmission Configurations, TransmissionComponents, Gears , Automobile Differential , Clutch, Brakes , Ideal Gearbox: Steady State Model , Gear Ratio (GR), Torque-Speed Characteristics , EV Motor Sizing , Initial Acceleration , Rated Vehicle Velocity, Maximum Velocity, Maximum Gradeability

Control of the Electric Drive
Introduction to Control- Feedback Controller Design Approach,Modelling the Electromechanical System, The Mechanical System, The PM DC Machine , The DC-DC Power Converter, The PI Controller , Designing Torque Loop Compensation . Designing Speed Control Loop Compensation, Acceleration of Battery Electric Vehicle (BEV) using PM DC Machine, Acceleration of BEV using WF DC Machine , Numericals

Teaching-Learning Process	Determining Compensator Gain Coefficients, for Torque Loop , Determining Compensator Gain Coefficientsfor Speed Loop 451

26.09.2022

Course outcome (Course Skill Set)

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

1. Understand and explain the constructional, design and working principles of different types of ICE and EV transmission systems.
2. Determine the various parameters of vehicle transmission systems.
3. Analyze the design parameters, necessity, advantages, constructional and principle of operation of different types of automatic transmissions and hydraulic control.
4. Apply the concept of transmission systems to design new systems for ICE and EVs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Electric Powertrain-Energy Systems, Power Electronics and Drives for Hybrid,Electric and Fuel Cell Vehicles, John G. Hayes ,G. Abas Goodarzi, © 2018 John Wiley & Sons Ltd
2. Advanced Vehicle Technology, Heinz Heisler 2002.
3. Automotive Transmissions and Power trains, Crouse W.H McGraw Hill Co. 5thedn, 1976.
4. Motor Vehicle Newton K and Steeds. W Butter Worth's & Co. Publishers Ltd,1997.
5. Automotive Mechanics , N.K. Giri Khanna Publication, New Delhi, 2014
6. Automobile Engineering. Kirpal Singh, Standard Pub. 2011

Web links and Video Lectures (e-Resources):

26.09.2022

1. .https://www.q8oils.com/automotive/automatic-transmission-systems/ 2. https://www.leithcars.com/blogs/1421/tutorials/how-manual-transmission-works/ 3. https://www.artofmanliness.com/skills/manly-know-how/how-automatic-transmission-works/ 4. https://gomechanic.in/blog/automatic-transmission-system-explained/ 5. https://www.youtube.com/watch?v=HfN5dEeUyuE 6. https://www.youtube.com/watch?v=WfiTscWVfWI
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Visit nearby EV dealer to understand and for hands on experience on ICE and EV transmission systems, compare and write a report

26.09.2022

PCCL- PCCL- Automotive Engine and EV drive Components Lab			
Course Code	**21AUL55**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0-0-2-0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- .To study the hand tools , understand application of materials and to write technical specifications of all types of engines
- Dismantling and assembling of SI and CI engines for dimension comparison, wear and tear inspection
- Calculate and compare the brake power, torque and mechanical efficiency of IC Engine and electrical motor of same configuration.
- Study the speed control of different types of electric drives/motors used in Electric Vehicles.

Sl.NO	Experiments
1	Study of Hand tools- sketching , material and their application
2	Writing Technical specifications and description of all types of engines
3	Dismantling and assembly of engines (SI and CI), identification of major components, and inspection of different components for wear, cracks, measurement and comparison of dimensions of major components with standard
4	Compression and vacuum test on diesel and petrol engines.
5	Two-wheeler chassis dynamometer
6	Speed control of DC motor using IGBT.
7	To perform speed reversal of DC Shunt motor
8	Calculate and compare the brake power, torque and mechanical efficiency of IC Engine and electrical motor of same configuration.
9	Voltage/frequency control of 3 phase induction motor
10	Speed control of BLDC Motor in two wheeler
11	Speed control of Switched Reluctance Motors (SRM) in three wheeler
12	MOSFET based step up and step down chopper
	Demonstration Experiments (For CIE)
12	Performance test on PEM fuel cell
13	Performance test on DMFC fuel cell
14	Demonstration of controllers and actuators in an electric vehicle

Course outcomes (Course Skill Set):

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

1. Thorough understanding of major components, their working and location identification of EVs and automobile engines .
2. Inspect and analyze the automobile components for functional defectiveness, wear and tear
3. Diagnose specific problem and make efforts to find the solution /troubleshooting.
4. Compare dimensional specifications of various but similar components of the automobile , both EVs and ICE from various manufacturers

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE). The students has to score in total (CIE+SEE) minimum of 40% of maximum marks of SEE and CIE put together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be

decided by the examiners) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours Rubrics suggested in Annexure-II of Regulation book
Suggested Learning Resources: • NPTEL course . You tube videos

26.09.2022

AUTOMOTIVE HEATING, VENTILATION AND AIR CONDITIONING			
Course Code	21AU581	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

- To understand the basics of automotive heating, ventilation and air conditioning
- To study the fundamentals of air-conditioning system used in vehicles
- To classify and choose the right refrigerant for the vehicle air conditioning
- To learn the basics of psychrometry
- To expose to the maintenance and service of air conditioning systems used in vehicles

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

7. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
8. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
9. Show Video/animation films to explain functioning of various machines
10. Encourage collaborative (Group Learning) Learning in the class
11. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
12. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
13. Topics will be introduced in a multiple representation.
14. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
15. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
16. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Air conditioning fundamentals: Fundamentals of refrigeration, basics of vehicle air conditioning system, location of air conditioning component in a car – schematic layout of a refrigeration system, component like compressor, condenser, fan blower, expansion device – expansion valve calibration , evaporator pressure regulator ,low and high pressure switch.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT and AU lab

Module-2	
Air conditioning heating system: Automotive heaters – manually controlled air conditioner – heater system – automatically control air conditioner – air conditioning protection with heater diagnosis chart.	
Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT and AU lab

Module-3
Refrigerants: Introduction, classification, properties, selection criteria, commonly used refrigerants, eco-friendly refrigerants, global warming and ozone forming potential of refrigerants, containers, handling of refrigerants.

26.09.2022

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT and AU lab
Module-4	
Psychrometry: Introduction, Psychometric properties, Inside and outside design conditions of air conditioning system. Air distribution: introduction, factors affecting design of air distribution system, types of air distribution system, air flow through the dashboard recalculating unit, duct system, ventilation, vacuum reserve.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT and AU lab
Module-5	
Air conditioning maintenance and service: Cause of air conditioner failure, trouble shooting of air conditioning system, servicing heater system, removing and replacing components, leak testing, compressor service, charging and discharging, performance testing.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT and AU lab

Course outcome (Course Skill Set)

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

1. Understand the basics of automotive heating, ventilation and air conditioning
2. Identify different components of heating, ventilation and air conditioning systems used in vehicles
3. Analyse the problems heating, ventilation and air conditioning systems used in vehicles and take up the basic service to rectify them

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Automotive air Conditioning William H. Crouse, Tata McGraw Hill publication;
2. Automotive air Conditioning, Mitchell information service, PHI;
3. Hucho. W.H. - “Aerodynamic of Road Vehicles” - Butterworths Co.,

Web links and Video Lectures (e-Resources):

15. .https://www.youtube.com/watch?v=nHZEAe08sE8
- https://www.youtube.com/watch?v=04MlTepEIz4
- https://www.youtube.com/watch?v=ODYEyAl8ztE
- https://www.youtube.com/watch?v=oAjGHaQ-tn0
- https://www.youtube.com/watch?v=NSUeRlJ2P0g

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

16. Watch http://www.digimat.in/nptel/courses/video/112105128/L42.html
17. NPTEL course certification

26.09.2022

AEC-Ability Enhancement Courses-V Digital Twin			
Course Code	**21AU582**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

1. To understand the Big Picture of Digital Twins, Applications of Digital Twins, Early Adopters of Digital Twins & Use Cases
2. To understand Implementing Digital Twin Aggregate (DTA), Digital Twins Tools & Technologies

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

INTRODUCTION, The Big Picture of Digital Twins, Applications of Digital Twins, Early Adopters of Digital Twins & Use Cases

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-2

DIGITAL TWINS ARCHITECTURE, Digital Twins – The Fundamentals, The Advanced Concepts of Digital Twins, Digital Twins Architecture, Design of Digital Twin for a Rotary Kiln in the Cement Industry

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Module-3

Implementing Digital Twin Aggregate (DTA), Digital Twins Tools & Technologies, Digital Twins vs Simulation – The Common Misconception

Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

26.09.2022

Module-4	
THE FUTURE OF DIGITAL TWINS, Digital Twins & Quantum Computing, Digital Twins & Blockchain, Digital Twins & Brain-Computer Interface	
Teaching-Learning Process	Digital Twins in Digital Transformation, Digital Twins & Environmental Causes, Digital Twins Beyond Industrial Use Cases
Module-5	
Digital Twin: Towards Internet of Drones, Digital Twin in Agriculture Sector: Detection of Disease using Deep Learning, , Crop Diseases Detection and Prevention using AI and Machine Learning Techniques Digital Twin and the Detection and Location of DoS attacks to Secure Cyber-Physical UAS Chapter 8: Digital twin techniques in Recognition of Human Action using the fusion of Convolutional Neural Network	
Teaching-Learning Process	Chalk and Talk, Video/animation films, Problem Based Learning (PBL), Lab session

Course outcome (Course Skill Set)

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

1. Understand the basics of Digital Twin Technology
2. Analyze the problems in the upcoming technology applications like drones, medical and Agri sector
3. Apply the concepts to address the societal related issues.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Digital Twin Technology, Edited By Gopal Chaudhary, Manju Khari, Mohamed Elhoseny, Copyright Year 2022, , ISBN 9781003132868 , Published October 5, 2021 by CRC Press

2. Digital Twin: A Complete Guide For The Complete Beginner, by Vijay Raghunathan , Santanu Deb Barma , Kindle Edition, 2021,

Web links and Video Lectures (e-Resources):

1. .https://dspace.mit.edu/bitstream/handle/1721.1/107989/04.Digital%20Twins.pdf?sequence=14
2. https://www.tcs.com/content/dam/tcs/pdf/discover-tcs/research-book/Digital%20Twin.pdf
3. https://www.ge.com/digital/industry/automotive
4. https://www.ge.com/digital/applications/digital-twin
5. https://virtualdutchman.com/category/digital-twin/
6.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Explore different software and resources on digital twin like

1. Digital Twins – Modelling and Simulations | Microsoft Azure
2. Digital Twin Software - Simio

26.09.2022

AEC-Ability Enhancement Courses-V Programming for Automobile engineers			
Course Code	21AU583	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:

1. To understand basics of programming
2. To implement the programming techniques to solve & visualize the numerical solutions for various engineering subjects

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various programming techniques
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1	
Basics of Programming-1: Variables, Scripts & Functions, Control statements: Conditional/Selection statements, Iteration/Loop statements, Jump statements	
Teaching-Learning Process	Any program language
Module-2	
Basics of Programming 2: Functions & Visualizing data (Various trigonometric signals such as sine,cosine,square etc.)	
Teaching-Learning Process	Any program language
Module-3	
Programming engineering Math: Solving ODE(Linear and Bernoulli's differential equations, Newton's law of cooling), Solving PDE(Solution of one-dimensional heat equation), Numerical methods (Newton-Raphson methods & Taylor Series)	

Teaching-Learning Process	Any program language

Module-4

Programming Mechanics: Solving conditions of limiting friction, impending motion on the horizontal and inclined planes, finding centroid and area moment of inertia, Numerical problems on support reactions for statically determinate beams (UDL,UVL and point loads)

Teaching-Learning Process	Any program language

Module-5

Programming Mechanics of materials: Visualizing and analyzing for various parameters for a typical stress-strain curves for ductile and brittle materials, Calculating shear forces on beams for different loading and boundary conditions, Calculating normal stresses in beams for rectangular and I sections

Teaching-Learning Process	Any program language

Course outcome (Course Skill Set)

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

1. Learn key concepts of programming
2. Visualize and analyse engineering problems analytically

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

26.09.2022

Suggested Learning Resources:

Books

1. Automate the Boring Stuff with Python: Practical Programming for Total Beginners, Al Sweigart, No starch press
2. *The Art of Clean Code*, Christian Mayer
3. MATLAB for Beginners: A Gentle Approach, **Peter I. Kattan**, Petra Books, ISBN: 978-1438203096
4. *Introduction to GNU Octave, Jason Lachniet*

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=kqtD5dpn9C8
2. https://www.youtube.com/watch?v=XM0CtrJYM2A
3. https://www.youtube.com/watch?v=2-OTwA7KeDQ&list=PL6xqi8nKo2yA98zG2moudwZpuWQK-iHmn&index=1

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

18. Practical based

AEC-Ability Enhancement Courses-V
Battery management system

Course Code	**21AU584**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1-0-0-0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1

Course objectives:
At the end of the course, students will be able to understand,

1. Basics and functionalities of battery management systems
2. Battery Pack sensing factors
3. Knowledge on Battery Protection and Interface with Energy estimation

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to BMS and BMS functionality- discussion of BMS functionality with sub-divisions, Battery pack topology,

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Module-2

Battery-pack sensing in terms Voltage, Temperature, Current. Hall effect sensors.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Module-3

High-voltage contactor control,Isolation sensing and thermal control, Protection and interface

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

26.09.2022

Module-4	
Charger control, Communication via CAN bus, Log book function, Range estimation, State-of-charge estimation	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)
Module-5	
Energy and power estimation, Pack total energy and pack total power, Diagnostics	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Course outcome (Course Skill Set)

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

1. Basics and functionalities of battery management systems
2. Battery Pack sensing factors
3. Knowledge on Battery Protection and Interface with Energy estimation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

26.09.2022

Suggested Learning Resources:

Books

1. Advanced Battery Management Technologies for Electric Vehicles
by Rui Xiong, Weixiang Shen, Wiley Publications
2. Battery Management System for Future Electric Vehicles, by Dirk Söffker and Bedatri Moulik, MDPI publishers

Web links and Video Lectures (e-Resources):

1. http://mocha-java.uccs.edu/ECE5720/ECE5720-Notes01.pdf
2. https://www.youtube.com/watch?v=cS5tkvbC4ts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

19. https://www.udemy.com/course/complete-battery-management-system-course-level-1/
20. https://training.ti.com/introduction-battery-management

26.09.2022

6TH SEMESTER

MANAGEMENT AND ENTREPRENEURSHIP			
Course Code	**21AU61**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Explain management functions of a manager. Also explain planning and decision-making processes, organizational structure, staffing and leadership processes, understanding of motivation and different control systems in management.
- Identify various types of supporting agencies and financing available for an entrepreneur
- Prepare project report and decide selection of industrial ownership.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as art or science, art or profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modem management approaches.

Planning: Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making, Importance of planning - steps in planning & planning premises - Hierarchy of plans.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Module-2

Organizing and Staffing: Nature and purpose of organization, Principles of organization – Types of organization-Departmentation Committees-Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of staffing :Process of Selection & Recruitment (in brief).

Controlling: Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief).

Directing: Meaning and nature of directing Leadership styles, Motivation, Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of coordination.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Module-3

26.09.2022

Entrepreneur: Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)
Module-4	
Planning a Start-up Enterprise: Forms of business organization/ ownership; Financing new enterprises – sources of capital for early-stage technology companies; Techno Economic Feasibility Assessment; Preparation of Business Plan for grants, loans and venture capital. Operational Issues for new enterprises: Financial management issues; Operational/ project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws.	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)
Module-5	
Small Scale Industries: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI - Government policy towards SSI; Ancillary Industry and Tiny Industry (Definition Only). **Institutional support:** Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC. **Industrial ownership:** Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed, Registration of Partnership Firm, Rights, Duties and Liabilities of Partners, Advantages and Disadvantages of Partnership, Sole proprietorship, Features, Scope	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, Practical Topics (Interactive session)

Course outcome (Course Skill Set)

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

1. Understand and explain management functions of a management analyse the organizational structure, staffing and leadership processes, understanding of motivation and different control systems in management.
2. Identify various types of supporting agencies and financing available for an entrepreneur.
3. Understand and plan a start-up ecosystem /enterprise
4. Prepare project report and decide industrial ownership.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Principles of Management P. C. Tripathi, P.N. Reddy, Tata McGraw Hill., 6th edition, 2017
2. Management Fundamentals Concepts, Application, Skill Development, Robers Lusier, Thomson., South western Cengage learning USA, 2012
3. Entrepreneurship Development S. S. Khanka S. Chand & Co. New Delhi. 2015.

Web links and Video Lectures (e-Resources):

1. Management and Entrepreneurship MSc - Cranfield University
2. https://library.shu.edu/entrepreneurship.
3. https://library.soton.ac.uk/business
4. https://www.startupindia.gov.in/content/sih/en/startup-scheme.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

21. Identify the schemes and the support for start-up ecosystem by GOI- https://startuptalky.com/list-of-government-initiatives-for-startups/

26.09.2022

IPCC - Automotive chassis and suspension			
Course Code	**21AU62**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-2-0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

1. Explain different chassis layouts and frames, Suspensions, Wheels and Tyres, Propeller Shaft, Differential and Rear Axles, etc.
2. Determine stability and weight distribution and suitability of frames.
3. Calculate dimensions of major chassis components.
4. Describe, about various Front Axles, factors of wheel alignment Steering Systems and Calculate dimensions of Front Axle.
5. Compare various types of Brakes and solve numerical.
6. Diagnose the troubles of chassis components and suggest remedies.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1	**8 HOURS**

Introduction: General consideration relating to chassis layout, power location, types of automobiles, layout of an automobile with reference to power plant, weight distribution, stability, Numerical problems. **Frames:** Types of frames ,general form & dimensions, materials, frame stresses, frame sections, cross members, proportions of channel sections, constructional details, loading points, sub frames, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, video/animation **Experiential learning through laboratory sessions (Experiment 1)**

MODULE-2	**8 HOURS**

Front Axle and Steering Systems: Axle parts and materials, loads and stresses, center sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, center
point steering, correct steering angle, steering mechanisms, cornering force, self-righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting,

26.09.2022

Teaching-Learning Process	Video/animation /Power point Presentation are used to show the working process, and other numerical can be solved with chalk and talk method. **Experiential learning through laboratory sessions (Experiment 2)**

MODULE-3	**8 HOURS**

Propeller Shaft: Construction & types of propeller shafts, whirling of propeller shaft, universal joints, analysis of Hooke's joint- ratio of shafts velocities, maximum & minimum speeds of driven shaft, condition for equal speeds of thee driving &driven shafts, angular acceleration of the driven shaft, maximum fluctuation of speed,
double Hooke's joint, Numerical problems.
Final drive: Construction details, types.
Differential: Principle, types of differential gears, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, transaxle types.
Rear axle: Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings, trouble shooting, numerical problems.

Teaching-Learning Process	Video/animation /Power point Presentation are used to show the working process and chalk and talk method of teaching, YouTube videos. **Experiential learning through laboratory sessions (Experiment 3)**

MODULE-48 HOURS

Brakes: Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, types of master, wheel cylinder, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc., Brake compensation, Parking and
emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, vacuum brakes
and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting.

Teaching-Learning Process	Video/animation for working of brakes, chalk and talk, Power Point Presentation. **Experiential learning through laboratory sessions (Experiment 4)**

MODULE 58 HOURS

Suspension system: Objects, basic considerations, Types of suspension springs, construction, operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension,

front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting.
Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.

Teaching-Learning Process	YouTube videos, chalk and talk, Power point presentation **Experiential learning through laboratory sessions (Experiment 5)**

26.09.2022

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Demonstration of basic structure of chassis and frames. Interaction between the teaching staff and the student.
2	Practical Topics (Interactive session): Demonstration of different type's axle and steering system: interaction between the teaching staff and the student.
3	Practical Topics: Demonstration of cut section of propeller shaft, final drive, differential, rear axle. Interaction between the teaching staff and the student.
4	Demonstration of cut section of different types of brakes and working. Interaction between the teaching staff and the student.
5	Demonstration of working of types of suspension system

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- . Explain different chassis layouts and frames, Suspensions, Wheels and Tires, Propeller Shaft, Differential and Rear Axles, etc.
- Determine stability and weight distribution and suitability of frames.
- Calculate dimensions of major chassis components.
- Describe, about various Front Axles, factors of wheel alignment Steering Systems and Calculate dimensions of Front Axle.
- Compare various types of Brakes and solve numerical.
- Diagnose the troubles of chassis components and suggest remedies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

.**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1. Automobile Engineering, Kirpal Singh, Standard publications, New Delhi12th edition Vol. I, 2009.
2. Automotive Mechanics,N. K. Giri Khanna Publications, New Delhi2008.
3. Steering, Suspension and Tyres,Giles. J. G. Iiiffe Book Co., London 1988.
4. Automotive Chassis,Heldt P. M Chilton Co., Literary Licensing, LLC,2012.
5. Automotive chassis and body,P. L. Kohli TMH. 2002

Web links and Video Lectures (e-Resources):

1. https://www.european-aluminium.eu/media/1555/aam-applications-chassis-suspension-0-introduction.pdf
2. https://www.youtube.com/watch?v=qfkTVYJIx8Q
3. https://axleaddict.com/cars/automotive-chassis-system
4. https://gomechanic.in/blog/car-suspension-explained/
5. https://www.thedrive.com/cars-101/39840/what-is-a-chassis
6. https://www.youtube.com/watch?v=PjenO8nihaM
7. https://wiregrass.libguides.com/c.php?g=1035978&p=7510014
8. https://www.youtube.com/watch?v=vaOrx-fqG0s

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

22. https://auto.howstuffworks.com/car-suspension.htm
23. https://ncert.nic.in/vocational/pdf/ivas103.pdf
24. https://en.wikipedia.org/wiki/Automotive_suspension_design_process

Vehicle Body Engineering and Safety

Course Code	21AU63	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Classify the vehicles and define basic terms.
- Select appropriate body material.
- Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body.
- Explain the ergonomics, stability the vehicle.
- Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methodsmay be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about
   the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class.
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their owncreative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve thestudents' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Classification of Coachwork: Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel arch structure, wheel arch, post diagonals, gussets.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, video/animation Practical Topics (Interactive session): Demonstration of basic structure of bus body, chassis and frames. Interaction between the teaching staff and the student.

Module-2

Vehicle Body Materials: Aluminium alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrene's,
load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their

Teaching-Learning Process	Video/animation /Power point Presentation are used to show the working process, and other numerical can be solved with chalk and talk method. Practical Topics (Interactive session): Demonstration of different type's composite materials: interaction between the teaching staff and the student.

Module-3

Aerodynamics: Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles. **Load Distribution:**Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

Teaching-Learning Process	Video/animation /Power point Presentation are used to show the aerodynamic forces and chalk and talk method of teaching, YouTube videos. Practical Topics: Demonstration of working of wind tunnel technology. Interaction between the teaching staff and the student.

Module-4

Interior Ergonomics: Introduction, Seating dimensions, Interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back passion reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout. Visibility, regulations, drivers visibility, methods of improving visibility, Window winding and seat adjustment mechanisms.

Vehicle Stability: Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

Teaching-Learning Process	Video/animation for working of brakes, chalk and talk, Power Point Presentation. Practical Topics: Demonstration of dash board instruments, electronic displays. Interaction between the teaching staff and the student.

Module-5

Noise and Vibration: Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression. **Impact protection:**Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargo restraint, passive restraint systems, side impact analysis, bumper system, energy absorbent
foams, laws of mechanisms applied to safety.

Teaching-Learning Process	YouTube videos, chalk and talk, Power point presentation

Course outcome (Course Skill Set)

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

- Classify the vehicles and define basic terms.
- Select appropriate body material.
- Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body.
- Explain the ergonomics, stability the vehicle.
- Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Vehicle body engineering Giles J PawlowskyBusiness books limited 1989
2. Vehicle body layout and analysis John FentonMechanical Engg. Publication ltd, London.1990Hand book on vehicle body design SAE publication.
3. Automotive chassis P.M. Heldt Chilton & Co 1970
4. Vehicle Safety 2002 Cornwell press Town bridge, UKISBN 1356 - 1448
5. Aerodynamics of Road Vehicles W.H.Butter worth's 1987 4th Edition

Web links and Video Lectures (e-Resources):

- https://www.slideshare.net/friendsrtg/vehicle-body-engineering-introduction
- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SAU1403.pdf
- https://www.youtube.com/watch?v=Qf6S9ApzNLQ
- https://www.youtube.com/watch?v=B9p2CWpu7VE
- http://www.gpmanesar.ac.in/GPContent/CBT-.pdf
- https://www.jstor.org/stable/44720562?seq=1#metadata_info_tab_contents

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

25. https://bie.tg.nic.in/Pdf/automobilechasis.pdf
26. https://www.youtube.com/watch?v=924_ZQMQh10
27. https://www.eqmsol.com/vehicle-body-engineering.php

26.09.2022

PROPULSION SYSTEM FOR ELECTRIC AND HYBRID VEHICLES			
Course Code	**21AU641**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives:

To provide necessary information/knowledge to students about the energy storage technologies, drive systems, control systems and energy management strategies in electric and hybrid electric vehicles

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methodsmay be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about
   the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class.
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters student's Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their owncreative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve thestudents' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Energy Storage Technologies:

Battery Systems- Lead-acid, Nickel metal hydride, Lithium ion.

Capacitor Systems- Symmetrical ultra-capacitors, Asymmetrical ultra-capacitors, Ultra-capacitors combined with batteries, Ultra-capacitor cell balancing, Electro-chemical double layer capacitor specification and test;

Hydrogen Storage- Metal hydride, High pressure gas; Flywheel systems; Pneumatic systems.

Teaching-Learning Process	• **Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations.** • **Demonstrations/field visits/industry visits**

Module-2

Electric Drive System Technologies:

Electric motors – Permanent Magnets, Brushless Machines, Interior Permanent Magnet, Asynchronous Machine, Variable Reluctance Machine, Relative Merits of Electric Machine Technologies. Hub motors - Construction and uses. Electric Drive Trains - basic calculation of torque and speed for electric vehicle.

Teaching-Learning Process	• **Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations.** • **Demonstrations/field visits/industry visits**

Module-3

26.09.2022

Electric Drive Control System: Need - Types – Controller components - DC to DC converter Alternator - Requirements of the Charging System - Charging System Principles - Charging methods - Regenerative power generation methods – Electric two-wheeler wiring circuit.	
Teaching-Learning Process	• **Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations.** • **Demonstrations/field visits/industry visits**
Module-4	
Hybrid Vehicle Architecture: Series Configuration, Pre-transmission parallel configuration, post-transmission parallel configuration, Hydraulic post-transmission hybrid, Flywheel systems Concept of hybrid electric drive train; Architecture of Hybrid Electric Vehicle Architecture- Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains-Torque-Coupling Parallel Hybrid Electric Drive Trains-Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains	
Teaching-Learning Process	• **Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations.** • **Demonstrations/field visits/industry visits**
Module-5	
Energy Management System: Energy management strategies with optimization techniques used in electric and hybrid electric vehicles. Classification of different energy management strategies. Comparison of different energy management strategies. Implementation issues of energy management strategies.	
Teaching-Learning Process	• **Conventional classroom teaching using teaching aids such as chalk & talk, PPTs and videos/animations.** • **Demonstrations/field visits/industry visits**
Course outcome (Course Skill Set) **At the end of the course the student will be able to:** 4. Explain the various energy storage systems used for electric and hybrid electric vehicles 5. Explain the working principles of various types of drives used in electric vehicles 6. Explain working principles of various control systems used in electric vehicles 7. Compare the architecture of hybrid electric vehicles 8. Explain and compare the different energy management strategies used in electric and hybrid electric vehicles	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design- Mehrdad Ehsani, Yimin Gao, Sebastian E Gay, Ali Emadi- CRC Press
2. Propulsion Systems for Hybrid Vehicles - John M Miller- The Institute of Engineering and Technology, Stevenage England -2011

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=6H5vtu5_SF4 (types of motors used in EV)
2. https://www.youtube.com/watch?v=k1N2LyXtK-k (battery management system)
3. https://nptel.ac.in/courses/108106170 (NPTEL Course- Fundamentals of Electric Vehicles: Technology & Economics)

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

28. Building electric bicycles/ mini two-wheeler using kits
29. **Industry / field visits**
30. **Laboratory demonstrations and through experiential learning.**

Principles of Alternative Energies			
Course Code	21AU642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

31. To understand role and significance of solar energy.
32. To discuss the importance of Wind Energy.
33. To be aware of the role geothermal energy in the Energy Generation.
34. To know the significance of ocean energy
35. To realize utilization of hydrogen energy and hydroelectric energy

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

SOLAR ENERGY

Introduction, Solar constant, Solar radiation measurements, Solar thermal conversion: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, Concentrators: optical design of concentrators, Solar radiation geometry, solar radiation data, Estimation of average solar radiation

Applications of solar energy: solar water heater, solar dryers, Solar ponds, solar cooling, Solar thermal power generation. Solar photovoltaic: Principle of photovoltaic conversion of solar energy. Solar cells, Solar PV pumps, Solar energy storage options.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Numerical of solar collectors, concentrators can be solved with chalk and talk method, Practical Topics (Interactive session)

Module-2

WIND ENERGY

Introduction, Basic principles of wind energy conversion, the nature of wind, power in the wind, wind energy conversion, wind data and energy estimation, site selection considerations, basic components of WECS, classification of WEC systems, wind energy collectors, horizontal axis machines, vertical axis machines, relative advantages and disadvantages, performances of wind machines, generating systems, Energy storage, applications of wind energy.

Teaching-Learning Process	YouTube videos/animation /Power point Presentation are used, and other numerical can be solved with chalk and talk method. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.

Module-3

26.09.2022

GEOTHERMAL ENERGY Introduction, estimates of Geothermal power, nature of Geothermal fields, Geothermal sources, hydrothermal resources, vapour dominated power plant, liquid dominated systems, characteristics of geo thermal steam electric plants, Geopressured resources, heat extraction from hot dry rocks, Magma resources Prime movers for geothermal energy conversion, advantages and disadvantages of geothermal energy, applications of Geothermal energy**,** Geothermal exploration, operational and environmental problems	
Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Interaction between the teaching staff and the student.
Module-4	
OCEAN ENERGY Introduction, Methods of ocean thermal electric power generation, open OTEC system, closed OTEC system, site selection**.** Principle of Tidal power generation, components of Tidal power plants, operation methods of utilization of Tidal energy site requirements, storage, advantages and limitations of Tidal power. Wave energy-introduction, advantages and disadvantages of wave energy, energy and power from the waves, wave energy conversion devices**.**	
Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Interaction between the teaching staff and the student.
Module-5	
HYDROGEN AND HYDROELECTRIC ENERGY Hydrogen Energy – introduction and application, General introduction to infrastructure requirement for hydrogen production, storage, dispensing & utilization. Electrochemical: Electrolysis, Photo electro chemical, Hydrogen storage methods, Hydrogen transportation, hydrogen utilization Small scale hydroelectric stations, classification, components, Design considerations for mini and micro hydel projects, bulb and tube turbine for small scale hydro electric, advantages and limitations of small scale hydro electric.	
Teaching-Learning Process	YouTube videos/animation /Power point Presentation are used, and other numerical can be solved with chalk and talk method. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.

Course outcome (Course Skill Set)

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

- Understand the role and significance of solar energy.
- Explain the importance of Wind Energy.
- Discuss the role of geothermal energy and ocean energy in the Energy Generation and its importance
- Illustrate the Utilization of hydrogen energy and hydroelectric energy

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fundamental of Renewable Energy Sources, Tiwari GN. Ghoshal MK. Narosa Publishers 2007
2. Power Plant Engineering Nag P K Tata McGraw Publishers Hill 2008
3. Solar Energy Sukatme, Tata McGraw Hill Publishers
4. Non Conventional Energy Sources G.D.Rai Khanna Publishers, New Delhi 2011
5. Chemical and Electrochemical Energy Systems, Narayan R. Biswanathan B University Press (India) Ltd. 1998.
6. Present and Future Automotive Fuels Osamu Hairo and Richard K John Wiley and Sons 1988
7. Renewable Energy Resources J W Twidell & A D Weir ELBS, 2006

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=BWqjPHGM5D0&list=PLwdnzlV3ogoUtaGiq-lVJc4CC6x_czs9D
2. https://www.youtube.com/watch?v=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk
3. https://www.youtube.com/watch?v=7Ry643d3deE&list=PL3QMEfkolRFbGhXveCE7RFDBgY0_gRxkh
4. https://www.youtube.com/watch?v=ie2bm3zHcxA&list=PLbjTnj-t5Gkl95LdB7O3bjUsstn5xg5MU

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

36. https://www.teachengineering.org/lessons/view/cub_environ_lesson09

- Professional Elective Course-I - - Hydraulics and Pneumatics			
Course Code	**21AU643**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

37. Explain basics of Hydraulics and pneumatics.
38. Describe Various components of hydraulic system and maintenance of hydraulic system
39. Design hydraulic system.
40. Describe layout and details of pneumatic systems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methodsmay be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about
   the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class.
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills suchas the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their owncreative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve thestudents' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Hydraulic Power: Pascal's law, The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, variable displacement pumps.
Hydraulic Actuators and Motors: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors and piston motors.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, video/animation Practical Topics (Interactive session): Demonstration of types of pump and motors. Interaction between the teaching staff and the student.

Module-2

Control Components in Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **Maintenance of Hydraulic systems:**Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting

Teaching-Learning Process	Video/animation /Power point Presentation are used to show the working process, and other numerical can be solved with chalk and talk method. Practical Topics (Interactive session): Demonstration of different type's valves and reservoir system: interaction between the teaching staff and the student.

26.09.2022

Module-3	
Hydraulic Circuit Design and Analysis: Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.	
Teaching-Learning Process	Video/animation /Power point Presentation are used to show the working process and chalk and talk method of teaching, YouTube videos. Practical Topics: Demonstration of different design circuits and analysis. Interaction between the teaching staff and the student.
Module-4	
Pneumatic Controls: Choice of working medium, characteristics of compressed air, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. **Pneumatic Actuators**: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals. Rod – less cylinders – types, working advantages. Rotary cylinder types construction. **Directional Control valves**: Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. **Simple Pneumatic Control:**Direct and indirect actuation pneumatic cylinders. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve.	
Teaching-Learning Process	Video/animation for working of brakes, chalk and talk, Power Point Presentation. Practical Topics: Demonstration of pneumatics and actuator working. Interaction between the teaching staff and the student.
Module-5	
Multi-cylinder Applications: Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro-Pneumatic control:**Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. **Multi-cylinder Applications**: Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro-Pneumatic control:**Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications.	
Teaching-Learning Process	YouTube videos, chalk and talk, Power point presentation

Course outcome (Course Skill Set)

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

Introduce basics of Hydraulics and pneumatics.

Describe Various components of hydraulic system and maintenance of hydraulic system

Design hydraulic system.

Describe layout and details of pneumatic systems.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. **Marks scored shall be proportionally reduced to 50 marks**
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fluid Power with applications,Anthony EspositoPearson education, Inc 2000.
2. Pneumatics and Hydraulics, Andrew Parr Jaico Publishing Co. 2000.
3. Systems – Principles and Maintenance,S. R. Majumdar, Tata McGraw Hill publishing company Ltd.2001
4. Pneumatic systems, S. R. Majumdar Tata McGraw Hill publishing Co1995.
5. Industrial Hydraulics,Pippenger Hicks McGraw Hill, New York. 2001

Web links and Video Lectures (e-Resources):

1. https://www.nexflow.com/blog/difference-between-pneumatics-and-hydraulics/
2. https://en.wikipedia.org/wiki/Hydraulics
3. https://www.explainthatstuff.com/hydraulics.html
4. https://fpsindia.net/how-do-hydraulics-work/
5. https://www.hafner-pneumatik.com/basic_concepts_of_pneumatics
6. https://www.youtube.com/watch?v=TjHNrvsx5bQ
7. https://www.youtube.com/watch?v=OP8n0KR4hA4
8. https://www.youtube.com/watch?v=NIxkUwtRnWA

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

41. Lab volt software to learn hydraulics https://labvolt.festo.com/solutions/3_fluid_power/98-6385-00_hydraulics_simulation_software_lvsim_hyd
42. https://library.automationdirect.com/pneumatic-system/
43. https://www.ispatguru.com/basics-of-pneumatics-and-pneumatic-systems/
44. https://manualzz.com/doc/7377199/hydraulics-simulation-software--lvsim%C2%AE-hyd---model-6385--...
45.

PEC -II- Finite Element Methods			
Course Code	**21AU644**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2 -2 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To comprehend the formulation methods in FEM.
2. To Identify the application of FEA elements
3. To be able to apply suitable boundary conditions to a global equation for heat transfer, fluid flow, axi symmetric and dynamic problems
4. To solve displacements, stress and strains induced.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Finite Element Method:

General description of the finite element method. Engineering applications of finite element method. Boundary conditions: homogeneous and nonhomogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretization process, Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Strain displacement relations, Stress strain relations, Plain stress and Plain strain conditions, temperature effects.

Interpolation models:

Simplex, complex and multiplex elements, Linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-2

26.09.2022

One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate's for1D, 2Delements. Higher order interpolation functions for 1D quadratic and cubic elements in natural coordinates, Constant strain triangle, Four-Nodded Tetrahedral Element (TET 4), Eight-Nodded Hexahedral Element (HEXA8), 2D iso-parametric element, Lagrange interpolation functions, Numerical integration: Gaussian quadrature one point, two point formulae, 2D integrals. Fore terms: Body force, traction force and point loads,

Numerical Problems:

Solution for displacement, stress and strain in 1D straight bars, stepped bars and tapered bars using elimination approach and penalty approach, Analysis of trusses

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-3

Beams and Shafts:

Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped beams using direct stiffness method with concentrated and uniformly distributed load.

Torsion of Shafts:

Finite element formulation of shafts, determination of stress and twists in circular shafts.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-4

Heat Transfer:

Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid, 1D finite element formulation using vibrational method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-5

Axi-symmetric Solid Elements:

Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels.

Dynamic Considerations:

Formulation for point mass and distributed masses, Consistent element mass matrix of one-dimensional bar element, truss element, axisymmetric triangular element, quadrilateral element, beam element. Lumped mass matrix of bar element, truss element, Evaluation of eigen values and eigen vectors, Applications to bars, stepped bars, and beams.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Course outcome (Course Skill Set)

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

5. Understand the concepts behind formulation methods in FEM.
6. Identify the application and characteristics of FEA elements such as bars, beams, plane andiso-parametric elements.
7. Develop element characteristic equation and generation of global equation.
8. Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi-symmetric and dynamic problems and solve them displacements, stress and strains induced.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

1. **Books**

1. Logan, D. L., A first course in the finite element method,6th Edition, Cengage Learning, 2016.
2. Rao, S. S., Finite element method in engineering, 5th Edition, Pergaman Int. Library of Science, 2010.
3. Chandrupatla T. R., Finite Elements in engineering, 2nd Edition, PHI, 2013.

REFERENCE BOOKS

1. J.N.Reddy, "Finite Element Method"- McGraw -Hill International Edition.Bathe K. J. Finite Elements Procedures, PHI.
2. Cook R. D., et al. "Conceptsand Application of Finite Elements Analysis"- 4th Edition, Wiley & Sons, 2003.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112104116
2. https://nptel.ac.in/courses/105105041

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

46. Use open source/student edition CFD software and solve simple problems . and analyze the results

26.09.2022

Autonomous vehicles			
Course Code	**21AU645**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Understand the Autonomous systems and its requirements , sensing, object recognition and tracking of an Autonomous system and do the error analysis of localization systems using the tools and techniques
2. Explain, plan and control the traffic behaviour, and create simple algorithms
3. Define the plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to autonomous driving: autonomous driving technologies overview, autonomous driving algorithms: Sensing, Perception, Object Recognition and Tracking:

Autonomous driving client system: Robot Operating System, Hardware platform:

Autonomous driving cloud platform: Simulation, HD Map Production, Deep learning Model Training

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources

Module-2

Autonomous vehicle localization:

Localization with GNSS: GNSS overview, GNSS error analysis, satellite based augmentation systems, real time kinematic and differential GPS, precise point positioning, GNSS INS integration Localization with LiDAR and HD maps

Visual Odometry: Stereo Visual Odometry, Monocular Visual Odometry, Visual Inertial Odometry, Dead Reckoning and Wheel Odometry; Sensor fusion

Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources

Module-3

26.09.2022

Perceptions In Autonomous driving: Introduction, Datasets, Detection, Segmentation, Sterio, Optical flow and Scene flow **Deep learning in Autonomous Driving Perception:** Convolutional Neural Networks, Detection, Semantic segmentation, Stereo and optical flow	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources
Module-4	
Prediction and Routing: Planning and control overview, Traffic prediction: Behaviour prediction as classification, Vehicle trajectory generation, **Lane level routing:** Constructing a weighted directed graph for routing, typical routing algorithms, routing graph cost	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources
Module-5	
Decision planning and control: Behavioural decisions, Motion planning, Feedback control Reinforcement Learning Based Planning and Control, **Client systems for Autonomous Driving**: Operating systems and computing platform **Cloud platform for Autonomous driving:** Introduction, infrastructure , simulation	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources
Course outcomes: At the end of the course the student will be able to: 1:Understand the Autonomous systems and its requirements 2:Explain algorithm, sensing, object recognition and tracking of an Autonomous system and do the error analysis of Localization systems using the tools and techniques 3:Explain, plan and control the traffic behaviour, and shall be able to do lane level routing and create simple algorithms 4. :Explain Plan and control motion, choose proper client systems for automotive vehicles and understand the cloud platform	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc, Creating Autonomous Vehicle Systems Morgan & Claypool Publishers 1st Edition, 2018
2. Ronald K. JurgenAutonomous Vehicles for Safer Driving SAE International Edition , 2013
3. Hod Lipson, Melba Kurman Driverless: Intelligent Cars and the Road ahead MIT Press. 1st Edition, 2016
4. Markus Maurer, J. Christian Gerdes, Barbara Lenz Autonomous Driving: Technical, Legal and Social Aspects 1st Edition, 2016
5. Hannah YeeFen Lim, Autonomous Vehicles and the Law: Technology, Algorithms and Ethics ,Edward Elgar Publishing. 1st Edition, 2018

Web links and Video Lectures (e-Resources):

1. https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/overview/autonomous-driving
2. https://www.techopedia.com/definition/30056/autonomous-vehicle
3. https://www.bmw.com/en/automotive-life/autonomous-driving.html

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Error analysis of Localization systems using the tools and techniques
2. **Cloud platform for Autonomous driving**, simulation

OEC-I-
Renewable Energy

Course Code	**21AU651**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

47. To Understand the Need, importance and scope of non conventional and alternate energy resources.
48. To understand role significance of solar energy.
49. To provide importance of Wind Energy. 4. To understand the role of ocean energy in the Energy Generation.
50. To get the utilization of Biogas plants and geothermal energy.
51. To understand the concept of energy Conservation

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

SOLAR ENERGY

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications. Solar Heating & Cooling System: Liquid based solar heating system, Natural, forced and gravity flow. – No numerical problems

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Practical Topics (Interactive session)

Module-2

INTRODUCTION TO WIND ENERGY

Atmospheric circulations, Factors influencing wind, Variation of wind speed with height and time, Turbulence, Causes of turbulence, Power estimation in wind, Wind energy conversion principles, Components of wind energy Conversion Systems (WECS), Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Wind electric generators: Aero generators classification: Synchronous generators, Induction generators, Variable speed generators.- Simple numerical problems

Teaching-Learning Process	YouTube videos/animation /Power point Presentation. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.

Module-3

26.09.2022

OCEAN ENERGY Introduction to Ocean Thermal Energy Conversion (OTEC), Temperature Gradient Curve with Ocean Depth, Methods of Ocean Thermal Electric Power Generation: Open OTEC, Closed OTEC and Hybrid OTEC, Merits and Demerits of OTEC, Introduction to Tides, Basic Principles of Tidal Power, Components of Tidal Power Plants, Methods of Utilization of Tidal Energy: Single Basin and Double Basin. – No numerical problems	
Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Interaction between the teaching staff and the student.
Module-4	
SMALL HYDRO POWER PLANT Hydrological cycle, Essential elements of hydraulic electric power plant, Hydraulic Machine: Turbines, General Layout of hydroelectric power plant, Classification of Hydraulic turbine: Impulse Turbine- Pelton Turbine, Reaction Turbine-Francis, Kaplan and Propeller Turbine;(Only theory with basic power and efficiency calculations, No velocity triangles) Small Hydro power plant, classification, overview of micro, mini and small hydro systems, components of small hydro power plant – Simple numerical problems on efficiency , power etc. – No numerical problems on velocity triangles	
Teaching-Learning Process	YouTube videos/animation /Power point Presentation are used, and other numerical can be solved with chalk and talk method. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
Module-5	
GEOTHERMAL ENERGY POWER PLANT Introduction of Geothermal Energy, Geothermal Resources, Nature of geothermal fields, Hydrothermal Power Plant: Vapour Dominated - High Pressure and Low Pressure & Liquid Dominated – Single Flash, Double Flash and Binary System; Geo-Pressurized; Hot dry rock; Magma Resources **BIOMASS-** Definition, Types of biomass resources and classification, production of biomass, characteristics of renewable feedstock for bio energy/bio fuel production; Basic chemistry of carbon compounds in biomass resources.	
Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation, Interaction between the teaching staff and the student.

Course outcome (Course Skill Set)

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

- To Describe the use of solar energy and the various components used in the energy production with respect to applications
- To appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
- To realize the role of ocean energy and hydro power plant in the energy generation.
- To understand the concept of Biomass energy resources geothermal energy principles and applications.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fundamental of Renewable Energy Sources, Tiwari GN. Ghoshal MK. Narosa Publishers 2007
2. Power Plant Engineering Nag P K Tata McGraw Publishers Hill 2008
3. Solar Energy Sukatme, Tata McGraw Hill Publishers
4. Non Conventional Energy Sources G.D.Rai Khanna Publishers, New Delhi 2011
5. Chemical and Electrochemical Energy Systems, Narayan R. Biswanathan B University Press (India) Ltd. 1998.
6. Present and Future Automotive Fuels Osamu Hairo and Richard K John Wiley and Sons 1988
7. Renewable Energy Resources J W Twidell & A D Weir ELBS, 2006

Web links and Video Lectures (e-Resources):

1. .https://www.youtube.com/watch?v=BWqjPHGM5D0&list=PLwdnzlV3ogoUtaGiq-lVJc4CC6x_czs9D
2. https://www.youtube.com/watch?v=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk
3. https://www.youtube.com/watch?v=7Ry643d3deE&list=PL3QMEfkolRFbGhXveCE7RFDBgY0_gRxkh
4. ttps://www.youtube.com/watch?v=ie2bm3zHcxA&list=PLbjTnj-t5Gkl95LdB7O3bjUsstn5xg5MU

OEC-I- Fundamentals Of I.C. Engines			
Course Code	**21AU652**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Explain constructional details and working of various components of internal combustion engine scavenging systems for two stroke engines.
2. Explain types of fuel system used for internal combustion engine.
3. Choose cooling and lubrication system for internal combustion engine
4. Analyze effect of supercharging and turbo charging on engine performance.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Construction and Operation: Engine classification, Constructional details of four stroke spark ignition (SI) and compression ignition (CI) engines. Working principles. Comparison of SI and CI engines, theoretical and actual valve timing diagrams for engines.
Engine Cycles: theoretical Otto, diesel and dual cycles, Fuel-air Cycles and Actual cycle

Teaching-Learning Process	Demo modules, cut out module and chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-2

Construction of engine parts: Cylinder, cylinder head, piston, piston pin, connecting rod, crank shaft, inlet and exhaust valves, flywheel, valve operating mechanisms**,**
Fuel Systems: Air fuel ratio requirements of SI engines, Working of a simple fixed venturi carburetor and limitations, gasoline injection system, types, Diesel fuel injection systems-inline pumps, distributor pumps, Types of Nozzles, Unit injector and common rail injection systems

Teaching-Learning Process	Cut out demo module , video for working of engine, chalk and talk, Power Point Presentation

Module-3

Cooling System: Necessity, variation of gas temperature, Areas of heat flow, heat transfer, piston and cylinder temperature, Heat rejected to coolant, quantity of water required, air cooling, water cooling, thermostats, pressurized water cooling, regenerative cooling, comparison of air and water cooling, radiators, antifreeze solution, types of coolant.
Lubrication System: Lubricants, lubricating systems, Lubrication of piston rings, bearings, oil consumption, additives and lubricity improvers, oil filters, pumps, and crankcase ventilation –types.

26.09.2022

Teaching-Learning Process	Cut out demo module , video for working of engine, chalk and talk, Power Point Presentation

Module-4

Supercharging and Turbo charging: Purpose, thermodynamic cycle, effect on the performance, turbo charging, limits of supercharging for petrol and diesel engines. Modifications of an engine for super charging - methods of super charging – super charging and turbo charging of two stroke and four stroke engines.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-5

Two Stroke Engines:
Principles and working of two stroke engine (SI & CI), Port timing diagrams. Types - Three port engine, Separate pumps or blowers, Symmetrical & unsymmetrical timing, Cross flow, loop flow & uniflow type Scavenging systems. Scavenging Process – Pre blow down, Blow down, Scavenging, Additional Charging. Theoretical Scavenging processes

Teaching-Learning Process	Cut out demo module , video for working of engine, chalk and talk, Power Point Presentation

Course outcome (Course Skill Set)

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

1. To explain constructional details and working of various components of internal combustion engine scavenging systems for two stroke engines.
2. To describe types of fuel system used for internal combustion engine.
3. To Choose cooling and lubrication system for internal combustion engine
4. To analyze effect of supercharging and turbo charging on engine performance.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Internal Combustion Engines, V. Ganesan, Tata McGraw Hill, 2007.
2. Internal Combustion Engines, Ramalingam K. K. Sci-Tech Publications, 2005.
3. Internal Combustion Engines, Mathur and Sharma Dhanpat Rai and Sons, 2002.
4. Fundamentals of Internal Combustion Engines, John B. Heywood. McGraw Hill International Edition, 1998.
5. A course in I. C. Engines Mathur & Sharma Dhanpat Rai& sons, New Delhi 1994.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=rvpMbBB6RrU&list=PL6kB4KeyhXc6GN3Gcvhl9YQEcMGD9M_Ym
- https://www.youtube.com/watch?v=DozLR0q6sUU&list=PLOEB17hxXqrYYTJQ67X83r2pIruXby6cp
- https://www.youtube.com/watch?v=CO2StedJtAc&list=PLwdnzlV3ogoXHbVNKWL1BYOo_8PpyNtnC

Basics of Thermal Engineering			
Course Code	**21AU653**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To introduce the fundamentals of basic thermodynamics and governing laws
2. To introduce the fluid mechanics fundamentals and definitions
3. To introduce the governing laws of heat transfer

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Fundamentals of Thermodynamics:

Thermodynamic definition and scope, Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume,

Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic. processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, (No numerical)

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Module-2

Zeroth law of thermodynamics, , Work and Heat: Thermodynamic definition of work; examples, sign Thermodynamic definition of work; examples, sign convention, Shaft work, Electrical work, other types of work. Heat; definition, units and sign convention, Simple Numerical only

Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources,

Module-3

26.09.2022

Laws of Thermodynamics : Joules experiments, Statement of the First law of thermodynamics, steady state-steady flow energy equation,important applications, Simple numerical problems on steady state-steady flow energy equation, Keivin –Planck &Clasius statement of Second law of Thermodynamics, PMM II and PMM I. equivalence of the two statements; Concept of Heat Engines and Heat pump, Simple numerical problems on heat engines/pump,	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab
Module-4	
Properties of fluids: Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension,capillarity, vapor pressure and cavitation. Simple numerical problems. **Fluid Statics:** Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge atmospheric and vacuum pressures, **Buoyancy:** Buoyancy, centre of buoyancy, meta centre and meta-centric height, conditions of equilibrium offloating and submerged bodies, determination of Meta-centric height experimentally and theoretically.(No numerical problems)	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to FM lab
Module-5	
Introductory concepts: Modes of heat transfer: Basic laws governing conduction, convection, and radiationheat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heattransfer mechanism. Simple Numerical problems on the above	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab

Course outcome (Course Skill Set)

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

1. Understand the basics of thermal engineering
2. Differentiate between the thermodynamics, fluid and heat transfer properties and interlink among them
3. Apply governing concepts of thermodynamics to solve simple practical problems
4. Analyse and correlate different properties

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Thermodynamics, An engineering approach, Yunus, A. Cenegal and Michael A.Boies, Tata Mac- Graw Hill Publishing Company, 2002
2. Engineering Thermodynamics P. K. Nag, Tata McGraw Hill, Pub.2002
3. Fluid Mechanics Bansal, R. K. Lakshmi Publications 2004.
4. Fluid Mechanics (SI Units) Yunus A. Cengel, John M.Cimbala, TMH 2006.
5. Heat transfer, a practical approach, Yunus A, Cengel,Tata McGraw Hill, 2001
6. Heat transfer P. K. Nag, Tata McGraw Hill, New Delhi, 2002.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112101097
2. http://platform.sysmoltd.com/
3. http://sourceforge.net/projects/dwsim/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL lecture videos,
2. Visit to Plant/Industry
3. Watch You tube videos

26.09.2022

Engineering Economics			
Course Code	**21AU654**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	

Course objectives:

On completion of this subject students will be able to

1. Understand the criterion to choose the best economic model from various available alternatives
2. Understand various interest rate methods and implement the suitable one.
3. Estimate various depreciation values of commodities using present, future and annual worth comparison methods
4. Understand the contents of a balance sheet and scope of finance.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Engineering Decision-Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Engineering Economic Decision, Maze.

Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loans and EMI Payment, Exercises and Discussion

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, NPTEL resources

Module-2

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present-worth, Assets with unequal lives, infinite lives,

Future-worth comparison, Pay-back comparison, Exercises, Discussions, and problems

Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources, NPTEL resources

26.09.2022

Module-3	
Equivalent Annual-Worth Comparisons: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, NPTEL resources
Module-4	
Costing and depreciation: Components of costs, estimation of selling price, marginal cost, first cost, all kinds of overheads, indirect cost estimation with depreciation, mensuration and estimation of material cost, **Depreciation:** causes of depreciation, methods of computing , depreciation charges, straight line method, declining balance method, sum of years method, sinking fund method, Discussions, and problems.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, NPTEL resources
Module-5	
Introduction, Scope Of Finance, Finance Functions: Statements of Financial Information: Introduction, Source of financial information, **Financial statements,** Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numerical	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, NPTEL resources

Course outcome (Course Skill Set)

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

1. Select the best economic model from various available alternatives
2. Understand various interest rate methods and implement the suitable one.
3. Choose the right depreciation method and estimate various depreciation values of commodities using appropriate -worth comparison methods
4. Apply the knowledge of economics and finance to evaluate interest, cost of components , depreciation balance sheet.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Engineering Economy, Riggs J.L., 4TH ed. , McGraw Hill, 2002
2. Engineering Economy, Thuesen H.G. PHI , 2002
3. Engineering Economy, Tarachand, 2000.
4. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000
5. Financial Management, Prasanna Chandra, 7th Ed., TMH, 2004
6. Financial Management, IM PANDEY, Vikas Pub. House, 2002

Web links and Video Lectures (e-Resources):

1. .https://www.youtube.com/watch?v=9yj6CtMUsYU
2. https://www.youtube.com/playlist?list=PLRW1FgIW06IpkWmpII_1qrXIPPzZdc7-V
3. https://nptel.ac.in/courses/110101005
4. https://www.youtube.com/watch?v=RaXQ8wQ6TUs

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Compare the Present worth, Annual worth and Future worth methods and analyse their relevance
2. Prepare a balance sheet for the company
3. Prepare the profit and loss account
4. Calculate the EMI of housing loan, car loan etc

PCCL-
Professional Core Course Lab
Modelling & ANALYSIS LAB

Course Code	**21AUL66**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0-0-2-0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:
The course is intended to provide basic understanding of Modeling and Analysis technique students with following aspects:

1. To acquire basic understanding of Modeling and Analysis software
2. To understand the different kinds of analysis and apply the basic principles to find out the stress and other related parameters of bars, beams loaded with loading conditions.
3. To apply the basic principles to carry out dynamic analysis to know the natural frequency of different kind of beams.

Sl.NO	Experiments
1	Bars of constant cross section area, tapered cross section area and stepped bar
2	Trusses – (Minimum 2 exercises of different types)
3	Beams – Simply supported, cantilever, beams with point load, UDL, beams with varying load etc(Minimum 6 exercises different nature)
4	Stress analysis of a rectangular plate with a circular hole
5	Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions (Minimum 4 exercises of different types)
6	Dynamic Analysis to find for natural frequency determination of Fixed – fixed beam
7	Dynamic Analysis to find frequency of Bar subjected to forcing function
8	Dynamic Analysis to find frequency of Fixed – fixed beam subjected to forcing function
	Demonstration Experiments (For CIE)
9	Demonstrate the use of graphics standards (IGES, STEP etc) to import the model from modeler to solver
10	Demonstrate one example of contact analysis to learn the procedure to carry out contact analysis.
11	Demonstrate at least two different types of example to model and analyze bars or plates made from composite material
12	

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

1. Demonstrate the basic features of an analysis package.
2. Use the modern tools to formulate the problem, and able to create geometry, discretize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading conditions.
3. Demonstrate the deflection of beams subjected to point, uniformly distributed and varying loads further to use the available results to draw shear force and bending moment diagrams.
4. Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.

5. Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours Rubrics suggested in Annexure-II of Regulation book
Suggested Learning Resources: • You tube videos • VTU e-resources

26.09.2022

MINI PROJECT			
Course Code	**21AUMP67**	CIE Marks	100
Teaching Hours/Week (L:T:P: S)	0 0 0 2	SEE Marks	-
Total Hours of Pedagogy	30	Total Marks	100
Credits	2	Exam Hours	-

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. ■

Mini-Project:

1.Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

2. A project monitoring committee shall be constituted consisting of internal guide, co-guide, and department/intra department senior faculty for periodic progress monitoring and guidance.

3. The above committee is responsible for timely evaluation of the project phase and finalization of CIE as per the rubrics defined either at the Institution level or at the department level or at the University level, whichever is applicable

Course outcomes:

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

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it. ■

Mini-project work:

Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini project:

(i) Single discipline:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

26.09.2022

Innovation/Entrepreneurship /Societal Internship			
Course Code	INT 21INT68	CIE Marks	100
Teaching Hours/Week (L:T:P: S)	0 0 0 2	SEE Marks	-
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	-

The duration of the Internship is **04 Weeks**

The students shall have to undergo a mandatory summer Internship-I in the intervening vocation of the 4th and5th semesters.

Each student of the Institute needs to have a Faculty Mentor. Faculty Mentor is a faculty from within the Institute who will guide students under him/her and keep track of the progress they are making at their Internship provider's end through proper communication from time to time. Faculty Mentor/Supervisors have to play active roles during the internship and a minimum of 20 students are to be supervised by each faculty mentor or as per the departmental strength.*(Supervisor/ Mentor's work can be treated as part of work load)*

Important Guidelines

1.Each student of the internshipshall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

2. A project monitoring committee shall be constituted consisting of internal guide, co-guide, and department/intra department senior faculty for periodic progress monitoring and guidance.

3. The above committee is responsible for timely evaluation of the internship and finalization of CIE as per the rubrics defined either at the Institution level or at the department level or at the University level, whichever is applicable

26.09.2022

Sl. No.	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Remarks
01	Participation in innovation-related completions for e.g. Hackathons etc.	Certificate	Faculty Mentor	
02	Working for the development of new product/ Business Plan/ registration of startup.	Certificate	Program Head	
03	Participation in all the activities of Institute's Innovation Council/ cell for e.g.: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc	Certificate	President/Convener of ICC	
04	Undergoing internship in state and central government organizations	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
05	Undergoing internship in Non-government organizations(NGOs)	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
06	Undergoing internship in Micro, Small and Medium Enterprises(MSME)	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
EVALUATION THROUGH SEMINAR PRESENTATION/VIVAVOICE AT THE INSTITUTE The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria: • **Quality of content presented.** • **Proper planning for presentation.** • **Effectiveness of presentation.** • **Depth of knowledge and skills.** • **Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report. Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students**				
07	Online Internships of a reputed company	Evaluation Report	Faculty Mentor/Company Coordinator	
08	Operational Internships- NSQF /skill councils etc	Evaluation Report	Faculty Mentor/NSQF Supervisor	
09	Providing knowledge or educating the rural people on 100% Digitalized Money Transaction (weekly 02 hours/80-90 hours total/20 activity points)	Certificate	Faculty Coordinator/NSS /NCC Head	
09	Preparing the actionable business proposal for enhancing the village income (2 hrs per week/80-90 hrs total/20 activity points)	Certificate	Faculty Coordinator/NSS /NCC Head	
10	Organizing and providing skills to rural	Certificate	Faculty	

26.09.2022

7TH SEMESTER

PCC Professional Core Course

AI and ML in Automotive Vehicles

Course Code	**21AU71**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Understand the core concepts of Mechanical Systems in the context of Industry 4.
2. Apply AI, ML and Deep Learning concepts on Various Mechanical Systems
3. Apply the statistical and optimization techniques on Mechanical Systems
4. Evaluate the Mechanical System performance using simulation and experimental analysis

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Mechanical Systems evolution in the context of Industry 4.0, Key issues: Adaptability, Intelligence, Autonomy, Safety, Sustainability, Interoperability, Flexibility of Mechanical Systems.

Introduction of Statistics; Descriptive statistics: Central tendency measures, Dispersion measures, data distributions, centre limit theorem, sampling, sampling methods; Inferential Statistics: Hypothesis testing, confidence level, degree of freedom, P-value, Chi-square test, ANOVA, Correlation V's Regression, Uses of Correlation and regression.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-2

Introduction: Overview of AI problems, examples of successful recent AI applications. The Turing test, Rational versus non-rational reasoning.

Search Strategies: Problem spaces (states, goals and operators), problem solving by search. Uninformed search (breadth-first, depth-first, depth first with iterative deepening). Heuristics and informed search (hill-climbing, generic best-first, A*). Minimax Search, Alpha-beta pruning

26.09.2022

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-3

Artificial Intelligence: Brief review of AI history, Problem formulation: Graph structure, Graph implementation, state space representation, search graph and search tree, Search Algorithms: random search, Depth-first, breadth-first search and uniform-cost search. Heuristic: Best first search, A* and AO* algorithm, generalization of search problems. Ontology; Fuzzy; Meta-heuristics.

Knowledge representation and reasoning: Review of propositional and predicate logic, First order logic, Resolution and theorem proving, Forward chaining, Backward chaining, Temporal and spatial reasoning. Review of probabilistic reasoning, Bayes theorem. Totally-ordered and partially-ordered Planning

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-4

Planning-The blocks world, Components of Planning Systems, Goal stack planning, Nonlinear planning, Hierarchical planning. Learning-Learning from example, Learning by advice, Explanation based learning, Learning in problem solving, Definition and examples of broad variety of machine learning tasks, Classification, Inductive learning, Simple statistical-based learning such as Naive Bayesian Classifier, decision trees.
Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification, Information retrieval, Pagerank, Information extraction, Question-answering
Agents: Definition of agents, Agent architectures (e.g., reactive, layered, cognitive), Multi-agent systems- Collaborating agents, Competitive agents, Swarm systems and biologically inspired models. Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-5

Machine Learning: Overview of supervised and unsupervised learning; Supervised Learning: Linear Regression, Non-linear Regression Model evaluation methods, Logistic Regression, Neural Networks; Unsupervised Learning: K-means clustering, C-means Clustering. Convolutional Neural Networks (CNN), Pooling, Padding Operations, Interpretability in CNNs, Limitations in CNN. Cases with respect to different mechanical systems.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Course outcome (Course Skill Set)

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

1. Understand the core concepts of Mechanical Systems in the context of Industry
2. Apply AI, ML and Deep Learning concepts on Various Mechanical Systems
3. Apply the statistical and optimization techniques on Mechanical Systems
4. Evaluate the Mechanical System performance using simulation and experimental analysis

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Rajkumar, Dionisio De Niz ,and Mark Klein, Cyber-Physical Systems, Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
3. Robert Levine et al., "A Comprehensive guide to AI and Expert Systems",McGraw Hill Inc, 1986.
4. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
5. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
6. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.
7. Montgomery Douglas, 2017. Design of Experiments, John Wiley and Sons, Inc
8. Elaine Rich, Kevin Knight and Shivashankar BNair, Artificial Intelligence Tata McGraw Hill3rd Edition 2009
9. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems Pearson Education1st Edition, 2015
10. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach Prentice Hall, 3rd Edition 2009

Masoud Yazdani, Artificial Intelligence: Principles and Applications, Chapman and Hall, 1986 Digital Edition,2008

Web links and Video Lectures (e-Resources):

1. .https://www.youtube.com/watch?v=OkAh2QiBn_w
2. https://www.youtube.com/watch?v=uO0U-6N7x1A
3. https://www.youtube.com/watch?v=AOFn2yKAI_8
4. https://www.youtube.com/watch?v=xW3fv5RYlGY
5. https://www.youtube.com/watch?v=K0imqzTWFOs

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. https://nptel.ac.in/courses/106106198
2. Certification program on the above course offered by NPTEL
3. https://nptel.ac.in/courses/106105166/

PCC-
Automotive Electrical and Electronic Systems

Course Code	**21AU72**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	2	Exam Hours	3

Course objectives:

1. Explain the construction of battery used in automotive vehicles.
2. Describe the construction and working of D.C. generator, alternator, cranking motor, ignition systems along with trouble shooting.
3. Discuss the faults arising in automotive wiring and lighting system.
4. Design layout of electrical systems.
5. Use transducers and sensors in electronic circuits.
6. Explain various aspects of electrical and Hybrid vehicles.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Earth return and insulated systems, 6 volts and 12 volts system, fusing of circuits, low and high voltage automobile cables, cable specifications, diagram of typical wiring system, and symbols used in automobile electrical systems. Storage Battery: Principle of lead acid cells, plates and their characteristics containers and separators, electrolyte and their preparation, effect of temperature on specific gravity of electrolyte, battery capacity and efficiency, battery rating, battery testing, methods of charging from D.C. mains, defects and remedies of batteries, care of idle and new batteries, different types of batteries and their principles like alkaline, lithium and zinc air etc

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-2

Generator/ Alternator: Principle of generation of direct current, generator details, shunt dynamos, armature reaction, action of three brush generator and battery in parallel, setting of third brush, voltage and current regulators, cutout relay - construction, working and adjustment. Construction and working of alternator and output control. Starter Motor & Drives: Battery motor starting system, condition at starting, behavior of starter during starting, series motor and its characteristics, considerations affecting size of motor, types of drives, starting circuit.

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-3

Ignition Systems: Ignition fundamentals, working of battery and magneto ignition systems, comparison of battery and magneto ignition system, advantages and disadvantages of conventional ignition systems, Types of solid state ignition systems, components, construction and working, high energy ignition distributors, Electronic spark timing control. Lighting System and Dashboard Instruments: Principle of automobile illumination, head lamp mounting and construction, sealed beam auxiliary lightings, horn, windscreen-wipers, signaling devices, electrical fuel pump, fuel, oil and temperature gauge, speedometer, odometer, etc. (Dash board instruments)

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-4

Engine Management Systems: Combined ignition and fuel management systems. Exhaust emission control, Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation. Complete vehicle control systems, Artificial intelligence and engine management. Hybrid vehicles and fuel cells. Chassis Electrical Systems: Antilock brakes (ABS), Active suspension, Traction control, Electronic control of automatic transmission, other chassis electrical systems, Central locking, Air bags and seat belt tensioners, seat heaters

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Module-5

Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. Transducers and Sensors: Definition and classification, principle of working and application of various light

26.09.2022

Teaching-Learning Process	Chalk and talk method of teaching, YouTube videos, Power Point presentation

Course outcome (Course Skill Set)

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

1. Explain the construction of battery used in automotive vehicles.
2. Describe the construction and working of D.C. generator, alternator, cranking motor, ignition systems along with trouble shooting.
3. Discuss the faults arising in automotive wiring and lighting system.
4. Design layout of electrical systems.
5. Use transducers and sensors in electronic circuits.
6. Explain various aspects of electrical and Hybrid vehicles

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Automobile Electrical and Electronic systems Tom Denton SAE publication. 2000
2. Automotive Electrical Equipment P. M. Kohli, Tata McGraw Hill, New Delhi. 1983 Reference Books
3. Advanced Engine Technology Heinz Heisler SAE Publications. 1995
4. Automotive Electronic Systems Ulrich Adler, Robert Bosch GMBH 1995 5 Mechatronics W. Bolton Longman, 2Ed, Pearson publications 2007

26.09.2022

Web links and Video Lectures (e-Resources):
1. https://www.youtube.com/watch?v=L7C1rVzI7kE 2. https://www.youtube.com/watch?v=mPwt0Tq_cBU 3. https://www.youtube.com/watch?v=JeLry3mJs6k 4. https://www.youtube.com/watch?v=Dm0IheybeUU 5. https://www.youtube.com/watch?v=Zpbj3C4RtBc
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Certification program by NPTEL https://nptel.ac.in/courses/107106088

26.09.2022

Hybrid Vehicle Technology			
Course Code	21AU731	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Understand the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
2. Explain hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
3. Analyze various electric drives suitable for hybrid electric vehicles. Discuss different energy storage technologies used for hybrid electric vehicles and their control.
4. Demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

INTRODUCTION:

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybridization of the Automobile: Vehicle Basics, Basics of the EV, Basics of the HEV, Basics of Plug-In Hybrid Electric Vehicle (PHEV), Basics of Fuel Cell Vehicles (FCVs). HEV Fundamentals: Introduction, Vehicle Model, Vehicle performance, EV Power train Component Sizing, Series Hybrid Vehicle, Parallel Hybrid Vehicle

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-2

HYBRID ELECTRIC VEHICLES

Introduction to Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.

Teaching-Learning Process	Power Point presentation, YouTube videos, Practical Topics (Interactive session)

Module-3

26.09.2022

ELECTRIC MACHINES AND DRIVES IN HEVS: Introduction, BLDC motors, Induction Motor Drives, Permanent Magnet Motor Drives, Switched Reluctance Motors, Doubly Salient Permanent Magnet Machines, Design and Sizing of Traction Motors, Thermal Analysis and Modelling of Traction Motors.	
Teaching-Learning Process	Cut out demo/actual machine module , video for working of machine, Power point Presentation are used, and other numerical can be solved with chalk and talk method.
Module-4	
ENERGY STORAGE: Batteries, Ultra capacitor, Introduction, Different batteries for EV, Battery Characterization, Comparison of Different Energy Storage Technologies for HEVs, Battery Charging Control, Charge Management of Storage Devices, Flywheel Energy Storage System. **FUEL CELL** Introduction, Technologies & Types, Obstacles. Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity.	
Teaching-Learning Process	Cut-out demo/actual models, YouTube videos, chalk and talk, Power point presentation, Practical Topics (Interactive session)
Module-5	
INTEGRATION OF SUBSYSTEMS: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems. **ENERGY MANAGEMENT STRATEGIES:** Introduction to energy management strategies used in hybrid and electric vehicle, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy strategies	
Teaching-Learning Process	Power Point presentation, YouTube videos

Course outcome (Course Skill Set)

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

- Understand the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
- Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
- Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored hsll be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press , 2003
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press , 2004
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley , 200
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd. , 2011

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=3E1SXG7VkQk&list=PLHRG-unM84XgZd9HKQAmKdE__12-1eRSe
2. https://www.youtube.com/watch?v=rK6Bey_loiw&list=PLdzIIxVTz4AsglVyHhZJ6Jj7tnpa3NL0n
3. https://www.youtube.com/watch?v=q6BYr5-fq5U
4. https://www.youtube.com/watch?v=UgtjRob5qMg&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Certification course by NPTEL https://nptel.ac.in/courses/108103009

26.09.2022

Energy Storage Systems for Electric Vehicles			
Course Code	21AU732	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Identify the energy storage system for the electric vehicles
- Compare different energy storage systems
- Analyse the data and design simple battery pack

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start -up ecosystem, incubation centers or MSME industries to give information about the industry culture and demand.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Energy Source: Battery : Battery Basics , Lead-Acid Battery :Cell Discharge Operation, Cell Charge Operation , Construction,

Alternative Batteries : Nickel-Cadmium Battery , Nickel-Metal-Hydride (NiMH), Battery, Li-Ion Battery, Li-Polymer Battery , Zinc-Air Battery , Sodium-Sulphur Battery , Sodium-Metal-Chloride Battery ,

Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-2

Battery Parameters , Battery Capacity, Discharge Rate, State of Charge, State of Discharge, Depth of Discharge Technical Characteristics, Practical Capacity , Capacity Redefined, Battery Energy , Constant Current Discharge , Specific Energy, Battery Power , Specific Power, Battery Pack Design , Ragone Plots , Targets and Properties of Batteries, Numerical problems on the above wherever applicable

Battery Modelling : Constant Current Discharge Approach, Fractional Depletion Model , Standard Driving Cycles , Power Density Approach,

Teaching-Learning Process	. Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Module-3

26.09.2022

Fuel Cells - Introduction to Fuel Cells , Fuel Cell Vehicle Emissions and Upstream Emissions , Hydrogen Safety Factors; Basic Operation - Fuel Cell Model and Cell Voltage , No-Load and Load Voltages of a PEM Fuel Cell , Power and Efficiency of Fuel Cell and Fuel Cell Power Plant System, Full-Load Power and Efficiency of PEM Fuel Cell Stack , Fuel Cell Characteristic Curves , Numerical problems on the above wherever applicable Sizing the Fuel Cell Plant,- Sizing a Fuel Cell , Balance of Plant , Boost DC-DC Converter; Fuel Cell Aging , Fuel Economy of Fuel Cell Electric Vehicle , Numerical problems on the above wherever applicable	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-4	
Fuel Cell Types - Alkaline Fuel Cell (AFC), Proton Exchange Membrane (PEM), Direct Methanol Fuel Cell (DMFC) , Phosphoric Acid Fuel Cell (PAFC) , Molten Carbonate Fuel Cell (MCFC) , Solid Oxide Fuel Cell (SOFC, ITSOFC) , Hydrogen Storage Systems, Reformers, Fuel Cell EV, Flywheel storage	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials
Module-5	
Battery Charging - Basic Requirements for Charging System , Charger Architectures , Grid Voltages, Frequencies, and Wiring , Charger Functions , Real Power, Apparent Power, and Power Factor. Charging Standards and Technologies , SAE J1772 422, VDE-AR-E 2623-2-2 425, CHAdeMo, Tesla ; Wireless Charging - Inductive , Wireless ; The Boost Converter for Power Factor Correction , The Boost PFC Power Stage ,Sizing the Boost Inductor , Average Currents in the Rectifier , Switch and Diode Average Currents , Switch, Diode, and Capacitor RMS Currents, Power Semiconductors for Charging , Silicon MOSFET and SiC Diode Power Losses	
Teaching-Learning Process	Chalk and Talk, PPT, You Tube videos, NPTEL sourced materials

Course outcome (Course Skill Set)

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

1. Identify the energy storage system for the electric vehicles
2. Compare different energy storage systems
3. Analyse the data and design simple battery pack

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, CRC Press, 2018, II Edition.
2. Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes ,University College Cork, Ireland ,G. Abas Goodarzi, US Hybrid, California, USA, © 2018 John Wiley & Sons Ltd
3. Electric Vehicle Technology Explained, 2nd Edition, James Larminie, John Lowry, ISBN: 978-1-119-94273-3, Wiley , July 2012

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc21_ee112/preview
2. https://www.digimat.in/limesurvey/index.php/108106182

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Design simple battery pack used in EV
2. Visit to nearby EV showroom / service centre

Vehicle Transport Management

Course Code	21AU733	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Explain infrastructure required for Fleet operation and maintenance.
2. Understand organizational structure and importance and methods of route planning.
3. Analyze different methods of fare collection systems.
4. Calculate fleet operating costs.
5. Formulate different methods of accident prevention.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Historical background, the growth of a network, trams, trolley buses, buses, private cars, subsidies. Motor vehicle act 1988.

The Infrastructure: Road, Highway network, traffic control, Bus priorities, pedestrianization, out town shopping centers, Bus-stops, shelters, Bus stations-drive through type, head on type, facilities for passengers, bus garages, requirement, layout of premises, size, function, , location, design, equipment, use of machinery, garage organization, large scale overhaul conveyance of staff, requirement of facilities at depot., legal provisions for depot. Layouts.

Maintenance: Preventive, breakdown, overhauling - major, minor, repair schedules & workshop, facilities, documentation, analysis & corrective maintenance schedules.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-2

Organization and Management: Forms of ownership, municipal undertaking, company undertaking, traffic, secretarial and engineering department, management, principle of transport, - internal organization-centralized control, de-centralized control, staff administration: industrial relation, administration, recruitment and training, drivers and conductors duties, training of drivers and conductors, factors affecting punctuality, welfare, health and safety.

Route planning: Source of traffic, town planning, turning points, stopping places, shelters, survey of route, preliminary schedule test runs, elimination of hazards, factors affecting frequency, direction of traffic flow, community of interest, estimating, traffic volume, probable weekday travelers, passengers during various periods of the day, estimated number of passengers, estimated traffic, possibility of single verses double deck and frequency.

Teaching-	Power Point presentation, YouTube videos,

26.09.2022

Learning Process	Interaction between the teaching staff and the student.

Module-3

Fare collections & Fare structure: Need, Principles of collection, tickets, the way bill, stage by stage, bell punch system, bell-graphic system, reduced ticket stocks will brew system, mechanical ticket machines, T.I.M and straight machines, Vero meter, one-man operation, two stream boarding, pre paid tickets, lensonparason coach tickets exchanges, the fare box, electronic ticket machines, box system personal and common stock flat fare platform control. Fare structure: Basis of fares, historical background, effects of competition and control, calculating average zone system, concession fares, straight and tapered scale elastic and inelastic demand coordination of fares concessions fares changes for workman, standard layout of fare table, anomalies double booking inter availability through booking and summation, private hire charges.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-4

Operating cost and types of vehicles: Classification of costs, average speed, running costs, supplementary costs, depreciation obsolescence, life of vehicles, sinking fund, factor affecting cost per vehicles mile incidence of wages and overheads, 100 seats miles basis, average seating capacity, vehicles size and spread over, types of vehicle economic considerations authorization of trolley, bus services, statuary for hire car.

Public relations divisions: Dissemination of information, maintaining goodwill- handling complaints, traffic advisory committees- local contractors co-operation with the press news and articles- facilities for visitors forms of publicity - importance of quality - inter departmental liaison advertisements, sings, notice and directions general appearance of premises, specialized publicity.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-5

Prevention of accidents: Emphasis of safe driving, annual awards, bonus encouragement, vehicle design, platform layout, location of stops, scheduled speed, route hazards, records, elimination of accident prone drivers.

Timing, Bus working and Schedules: Time table layout, uses of flat graph method of presentation, preparation of vehicle and crew schedule preparation of the duty roster, co-operation with employers, use of the vehicle running numbering determination of vehicle efficiency checking efficiency of crew, duty arrangements.

Vehicle design: Buses & coaches, types & capacities, basic features, entrances & exits, comfort & capacity, steps & staircases, miscellaneous arrangements & fitments, articulated buses, standardization. The future: a projection from the past, future demand, environmental and social issues, the energy situation, new technology, hybrid ,battery/trolley bus, other types of hybrid, lead acid battery bus, advanced battery bus.

Teaching-Learning Process	Power Point presentation, YouTube videos, Practical Topics (Interactive session)

Course outcome (Course Skill Set)

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

1. Explain infrastructure required for Fleet operation and maintenance.
2. Understand organizational structure and importance and methods of route planning.
3. Analyze different methods of fare collection systems.
4. Calculate fleet operating costs and Formulate different methods of accident prevention.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored hsall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Bus operation L. D. Kitchen, Iliffe&Sons , London . 1992
2. Bus & coach operation Rex W. Faulks, Butterworth London. 1987
3. M. V. Act 1988, Central Law Agency, 1995
4. Compendium of transport terms - CIRT, Pune 2001

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=YDwWdBLaRgU
2. https://www.youtube.com/watch?v=Q31jKiEXxdc
3. https://www.youtube.com/watch?v=aswfxJ2H0dA&list=PLLy_2iUCG87A6dwmEFv_ET4Bb0wAVcUrx
4. https://www.youtube.com/watch?v=YAEyLOCU-8I&list=PLA5B61833B976038C

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL COURSES :https://nptel.ac.in/courses/105101008
2. NPTEL COURSES https://onlinecourses.nptel.ac.in/noc22_ce41/preview

Industry 4.0 for Automotive Vehicles			
Course Code	21AU734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the Industry 4.0 concept , globalization and emerging issues
- Understand the concept of IIOT , study the elements of IIOT application of IIOT under industry context
- Learn the development procedures involved in IIOT

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Industry 4.0: Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories,
Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-2

Introduction to IIoT: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Module-3

26.09.2022

Elements of IIoT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API‟s (using Python/Node.js/Arduino) for Communication Protocols- MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.	
Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.
Module-4	
IIoT Application Development : Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices	
Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.
Module-5	
Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation	
Teaching-Learning Process	Power Point presentation, YouTube videos, Interaction between the teaching staff and the student.

Course outcome (Course Skill Set)

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

1. Explore how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain.
2. Understand the drivers and enablers of Industry 4.0.
3. Learn about various IIoT-related protocols.
4. Build simple IIoT Systems using Arduino and Raspberry Pi.
5. Analyse and implement the concept in real life applications

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Arshdeep Bahga,Vijay Madisetti Ïnternet of Things, "A Hands on Approach University Press 1st **Edition,** 2015
2. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases , CRC Press, **1stEddition,** 2017.
3. SRN Reddy, RachitThukral and Manasi Mishra, Introduction to Internet of Things: A practical Approach ETI Labs, **Edition,** 2017
4. Adrian McEwen , Designing the Internet of Things, Wiley**1st Edition,** 2013.
5. Raj Kamal Internet of Things : Architecture and Design McGraw Hill **1st Edition,** 2017

Web links and Video Lectures (e-Resources):

1. http://library.fes.de/pdf-files/bueros/indien/15840.pdf
2. https://www.youtube.com/watch?v=ZYPpTWtQTFY
3. https://www.youtube.com/watch?v=3WykDG5L_5A
4. https://www.youtube.com/watch?v=etuDLZfUImQ
5. https://www.youtube.com/watch?v=APFuXkMbwGE&vl=en
6. https://www.youtube.com/watch?v=IrtH38nK8fo

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Certification course by NPTEL : https://nptel.ac.in/courses/106105195
2. Certification course by NPTEL :https://onlinecourses.nptel.ac.in/noc20_cs69/preview

PEC -II- Ability Enhancement Courses-IV Factory Physics			
Course Code	**21AU735**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To introduce the concepts of factory physics, highlighting its effectiveness over other established techniques
2. To introduce the governing principles of factory physics with an understanding of the behavior of manufacturing systems and improve the management practice.

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, start-up ecosystems, incubation centers or MSME industries to give information about the current practices of industry culture and demand.
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teachers can devise innovative pedagogy to improve teaching-learning.

Module-1

Introduction to Factory Physics: Introduction and need for factory physics with an example, Science of Manufacturing, Basics and importance of Factory Physics, Strategic and Operational Objectives, Models and Performance Measures, A Methodology for Improvement

Basic Factory Dynamics: Definitions and Parameters, Best-Case Performance, Worst-Case Performance, Practical Worst-Case Performance, Bottleneck Rates and Cycle Time

Teaching-Learning Process	1. A general introduction to factory physics could be done considering the need and its importance against the established techniques such as Just-In-Time and Lean Manufacturing 2. The focus should be made on the problems associated with the established techniques. This will give the reader an idea of the importance of factory physics

Module-2

Variability Basics: Variability and Randomness, Process Time Variability (measures and Classes of Variability & Low and Moderate Variability), Causes of Variability, Flow Variability, Queueing Notation and Measures, Fundamental Relations, The M/M/l Queue & Performance Measures

The Corrupting Influence of Variability: Examples of Good and Bad Variability, Variability Laws (Buffering Examples & Pay Me Now or Pay Me Later), Flow Laws, Batching Laws, Diagnostics and Improvements

Teaching-Learning Process	1. Showcasing the importance of good and bad variability with broad examples of different organizations

	2. Powerpoint presentations would be a more suitable option
Module-3	
Push and Pull Production Systems: Perceptions of Pull, Reducing Manufacturing Costs, Reducing Variability, Facilitating Work, CONWIP, Comparisons of CONWIP with MRP, Comparisons of CONWIP with Kanban **The Human Element in Operations Management:** Basic Human Laws, Planning versus Motivating, Responsibility and Authority	
Teaching-Learning Process	1. Mode of Instruction: Powerpoint presentation with suitable examples
Module-4	
A Pull Planning Framework: Disaggregation, Forecasting, Hierarchical Production Planning (Capacity/Facility Planning, Workforce Planning, Aggregate Planning, Real-Time Simulation, Production Tracking), **Shop Floor Control:** General Considerations, CONWIP Configurations (Basic CONWIP, Tandem CONWIP Lines, Multiple-Product Families, CONWIP Assembly Lines), Pull-from-the-Bottleneck Methods, Long-Range Capacity Tracking	
Teaching-Learning Process	1. Mode of Instruction: Powerpoint presentation with suitable examples
Module-5	
Production Scheduling: Goals of Production Scheduling, Review of Scheduling Research (MRP, MRP II, and ERP, Classic Machine Scheduling, Dispatching, Why Scheduling Is Hard), Linking Planning and Scheduling, Production Scheduling in a Pull Environment **Aggregate and Workforce Planning:** Basic Aggregate Planning, Product Mix Planning, Workforce Planning (An LP Model, A Combined AP/WP Example) **Synthesis-Pulling It All Together:** Strategic Importance of Details, Practical Matter of Implementation, Focusing Teamwork	
Teaching-Learning Process	1. Mode of Instruction: Powerpoint presentation with suitable examples 2. Real examples could be discussed in the class through different case studies

Course outcome (Course Skill Set)

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

1. How engineers work with the natural tendencies of manufacturing systems
2. Identify opportunities for improving existing systems
3. Design effective new systems
4. Make the trade-offs needed to coordinate policies from disparate areas

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Factory Physics: Foundations of Manufacturing Management, first edition, 1996. 668pp. ISBN 0-256-15464-3

Web links and Video Lectures (e-Resources):

1. http://cdsweb.cern.ch/record/2790354?ln=no

PEC
Professional elective Course-III
Safety of Electric Vehicles

Course Code	21AU741	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To Identify safety systems of automobiles
2. To Classify safety systems and components
3. To describe the working principles of comfort and convenience systems
4. To Examine vehicle maintenance.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.
1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Design of the vehicle body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Module-2

Safety Concepts: Active safety, driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Module-3

Active Safety: Cruise control system, Lane departure warning, Tire pressure monitoring system, Electronic braking.

Passive Safety Equipments: Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Module-4

Collision Warning and Avoidance: Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

Comfort and Convenience System: Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Module-5

Preventive Maintenance of Engine And Transmission Line: Maintenance of cooling and lubricating systems, engine management service - fault diagnosis- servicing emission controls. Scheduling of maintenance of light duty, heavy duty vehicles

Clutch, transmission, axles: general checks, adjustment and service, fault diagnosis. Steering, Brake, Suspension, Wheel Maintenance: Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Course outcome (Course Skill Set)

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

1. Identify different safety systems and its role in automobiles
2. Classify active, passive safety systems and components
3. Describe the working principles of air-bag, ABS, seat-belt controls, comfort and convenience systems
4. Examine vehicle maintenance, trouble shooting and suggest as remedial measures.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Automotive Handbook, Bosch, 8 th Edition, SAE publication, 2011.
2. Automotive Mechanics, Srinivasan, S, 2nd Edition, Tata McGraw- Hill, 2015
3. An Introduction to Modern Vehicle Design, Jullian Happian-Smith, SAE, 2002
4. Crashworthiness of Vehicles, Johnson, W., and Mamalis, A.G., MEP, London, 1995
5. Rollover Prevention, Crash Avoidance, Crashworthiness, Ergonomics and Human Factors, SAE Special Publication, November 2003

Web links and Video Lectures (e-Resources):

1. .https://www.youtube.com/watch?v=rqUDzNHKE_U
2. https://www.youtube.com/watch?v=Ri_B2DIrXUI
3. https://www.youtube.com/watch?v=NHD6H27iCvQ
4. https://www.youtube.com/watch?v=r4DAxfO4gow
5. https://www.firerescue1.com/fire-prevention/videos/electric-vehicle-safety-training-preview-bRGTo1WiuD1vFukK/
6. https://www.nfpa.org/EV
7. https://www.youtube.com/watch?v=h1VTFpnTkck

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL Certfication course :https://nptel.ac.in/courses/108102121
2. NPTEL Certfication course :https://www.youtube.com/watch?v=W_Fp7nGgz9k

PEC
Professional elective Course-III
Total Quality Management

Course Code	21AU742	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Explain basic concepts of TQM, leader ship qualities, different factors of customer satisfaction andbenefits of involvement of employee in quality management
- Describe various techniques for continuous process improvement and its benefits, importance ofHR dept.
- Apply various tools and techniques in industries to achieve the higher productivityConduct recruitment process, training of employees.
- Understand use of various graphical representation of process behaviour in TQM

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to TQM:

Introduction-Definition, Basic Approach, and Contribution of Gurus - TQM framework, Historical Review, Benefits of TQM, TQM organization.

Leadership, Customer Satisfaction and Employee Involvement:

Characteristics of quality leaders, Customers satisfaction, Customer perception of quality, Feedback, Using customer's complaints, Employee involvement - Introduction,

Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Module-2

Continuous Process Improvement and Tools Techniques:

The juran trilogy, improvement strategies, types of problems, the PDSA cycle, problem solving methods,Kaizen, reengineering, six sigma, Process of benchmarking, quality function deployment, quality by design, Simple numerical treatment wherever applicable

Teaching-Learning Process	.

Module-3

26.09.2022

Quality Management Tools: Why- why forced filed analysis, nominal group techniques, affinity diagram, interrelationship diagram, Treediagram, matrix diagram, process decision programme chart, activity network diagram, prioritization matrices. , Simple numerical treatment wherever applicable	
Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,
Module-4	
Human Resource Practices: Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal. Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies, , Simple numerical treatment wherever applicable	
Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,
Module-5	
Statistical Process Control: Paratodigram, process flow diagram, fishbone diagram, histograms, check sheets, statistical fundamentals.Control charts, types of control charts, scattered diagrams case studies and numerical problems.m , Simple numerical treatment wherever applicable	
Teaching-Learning Process	Chalk and Talk. Power Point presentation, YouTube videos,

Course outcome (Course Skill Set)

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

1. Explain basic concepts of TQM, leader ship qualities, different factors of customer satisfaction and benefits of involvement of employee in quality management
2. Describe various techniques for continuous process improvement and its benefits, importance ofHR dept.
3. Apply various tools and techniques in industries to achieve the higher productivity
4. Conduct recruitment process, training of employee and use various graphical representation of process behavior in TQM

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Total Quality Management: Dale H. Besterfield, Publisher -Pearson Education India, ISBN: 8129702606, Edition 03.
2. Total Quality Management for Engineers: M. Zairi, ISBN:1855730243, Publisher: Wood head Publishing
3. Managing for Quality and Performance Excellence by James R.Evans and Williuam M Lindsay,9th edition, Publisher Cengage Learning.
4. . A New American TQM, four revolutions in management, ShojiShiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
5. Organizational Excellence through TQM, H. Lal, New age Publications, 2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=NWsw9tKhRg8
2. https://www.digimat.in/nptel/courses/video/110104085/L01.html
3. https://www.youtube.com/watch?v=umqtSNPp5Dk
4. https://www.youtube.com/watch?v=8qaYone7J_A
5. https://www.youtube.com/watch?v=85Y8iBhzqwk

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL Certfication course : https://onlinecourses.nptel.ac.in/noc20_mg34/preview
2. NPTEL Certfication course : https://www.youtube.com/watch?v=SMOQV2CyVQo

PEC
Professional elective Course-III
Computational Fluid Dynamics

Course Code	**21AU743**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Know the basic equations of fluid dynamics, boundary layer and discretization.
2. Understand the source and vortex panel method.
3. Know about FDM, FVM and FEM

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the motion of flow of fluid stressing upon its velocity and the pressure
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teachers can devise innovative pedagogy to improve teaching-learning.

Module-1

Introduction: CFD Applications. Need for Parallel Computers in CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity. Continuity, Momentum, and Energy Equations-Derivation in various forms. Integral versus a Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of equations are especially suitable for CFD work. Shock capturing and shock fitting.

Teaching-Learning Process	This being an introductory chapter could be more inclined towards using powerpoint presentations. However, the rest of the topics, which includes derivations of the governing differential equations, could be taught using chalk and talk

Module-2

Mathematical Behaviour of Partial Differential Equations: Classification of partial differential equations. Cramer Rule andEigenvalue methods for classification. Hyperbolic, parabolic, andelliptic forms of equations. Impact of classification on physical and computational fluid dynamics. Case studies: steady inviscid supersonic flow, unsteady inviscid flow, steady boundary layer flow and unsteady thermal conduction, steady subsonic inviscid flow.

Teaching-Learning Process	This module could be explained using chalk and talk with some Powerpoint presentations for highlighting the difference between the various forms of flow

Module-3

Grid Generation and Adaptive Grids: Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Structured Grid generation techniques- algebraic and numerical methods. Unstructured Grids-essential features. Unstructured Grid generation techniques- Delaunay-Voronoi diagram, advancing front method. Surface grid generation, multi-block grid generation, and meshless methods. Grid quality and adaptive grids. Structured grids adaptive methods and unstructured grids adaptive methods.

Teaching-Learning Process	The various forms of grid generation technique could be taught using the chalk and talk method. At the same time, the rest could be highlighted using Powerpoint presentations.

Module-4

Discretisation & Transformation:

Discretization: Finite differences methods and difference equations. Explicit and Implicit approaches. Unsteady Problem -Explicit versus Implicit Scheme. Errors and stability analysis. Time marching and space marching. Reflection boundary condition. Relaxation techniques. Alternating direction implicit method. Successive over-relaxation/under relaxation. Second-order Lax-Wendroff method, mid-point Leapfrog method, upwind scheme, numerical viscosity, and artificial viscosity.

Transformation: Transformation of governing partial differential equations from the physical to the computational domain. Matrices and Jacobians of transformation. Example of transformation. Generic form of the Governing flow equations in Strong Conservative form in the Transformed Space.

Teaching-Learning Process	The topics could be taught with the chalk and talk and Powerpoint presentations

Module-5

Finite Volume Technique and Some Applications: Spatial discretization- cell-centered and cell vertex techniques (overlapping control volume, duel control volume). Temporal discretization- Explicit time-stepping and implicit time stepping. Time step calculation. Upwind scheme and high-resolution scheme. Flux vector splitting, approximate factorisation. Artificial dissipation and flux limiters. Unsteady flows and heat conduction problems. Upwind biasing.

Teaching-Learning Process	The topics could be taught with the chalk and talk and Power point presentations

Course outcome (Course Skill Set)

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

1. Differentiate the FDM, FVM and FEM
2. Perform the flow, structural and thermal analysis.
3. Utilize the discretization methods according to the application.

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Applied Computational Fluid Dynamics, Gupta S.C Wiley, India 2019
2. Computational Fluid Dynamics John D. Anderson McGraw Hill 2013
3. Computational Fluid Dynamics - An Introduction, John F. Wendt, Springer 3rd Edition, 2013

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112107080
2. https://www.youtube.com/watch?v=t7jS7V_6TGQ

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Combined with M&A Lab

PEC Professional elective Course-III Infotainment & Cyber Physical System			
Course Code	21AU744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Understand the basics of infotainment and cyber security systems
2. Learn different types of cyber security issues and operating system
3. Understand essentials of cryptography, program, web, network, and Operating system details

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Infotainment Systems: Infotainment Systems on Fast Forward , Adaptive In-Vehicle Information Systems and Their Usability Evaluation ,
Infotainment System Immunity Characterization Via Bulk Current Injection, Incorporating Hard Disks in Vehicles - Usages and Challenges, Multi-User Infotainment System

Teaching-Learning Process	Chalk and talk, You Tube videos, NPTEL lecture series, Visual inspection / input from the industry experts

Module-2

Introduction to Cyber security: Security Goals, Attacks, Services and Mechanisms – Techniques – Understanding Threats.

CRYPTOGRAPHY:

Basic encryption and decryption – Substitution, Transposition – AES- Public key cryptosystem: RSA cryptosystem –Data Integrity- Cryptography hash functions- Digital Signatures-Digital signature standard(DSS)- Authentication- Passwords-Biometrics-Interactive protocol- Key management – Diffie –Hellman Key exchange- Digital certificates.

Teaching-Learning Process	. Chalk and talk, You Tube videos, NPTEL lecture series, Visual inspection / input from the industry experts

26.09.2022

Module-3	
PROGRAM SECURITY: Secure Programs – Buffer overflows – Malware – viruses and other malicious code – Targeted Malicious code –Défense Mechanism.	
Teaching-Learning Process	Chalk and talk, You Tube videos, NPTEL lecture series, Visual inspection / input from the industry experts
Module-4	
NETWORK SECURITY: Security at application layer: email security – SMIME- Security at transport layer: SSL protocol. Security at network layer: firewalls – intrusion detection system – IPsec	
Teaching-Learning Process	Chalk and talk, You Tube videos, NPTEL lecture series, Visual inspection / input from the industry experts
Module-5	
WEB SECURITY: Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS),Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection. **OS SECURITY:** Memory and Address protection – Access Control –file protection mechanisms –User authentication –models of security –Trusted OS design.	
Teaching-Learning Process	Chalk and talk, You Tube videos, NPTEL lecture series, Visual inspection / input from the industry experts

Course outcome (Course Skill Set)

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

1. Understand the basic functions of infotainment and cyber security systems
2. Analyse the types of cyber security issues and operating system issues
3. Apply the knowledge of security issues and diagnose the problem
4. Compare the different types of infotainment and cyber security systems used by the automotive manufacturers

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Infotainment Systems, Ronald K. Jurgen, ISBN: 0768019435 / 9780768019438,Publisher: SAE, Year: 2007
2. James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", CRC Press, USA, 2011
3. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata Mc-Graw Hill, 2010.
4. William Stallings, "Cryptography and Network Security", Prentice Hall, 2006.
5. Roberta Bragg, Mark Rhodes, Keith Strass Berg J, "Network Security- The Complete Reference", Tata McGraw Hill, 2006.
6. Brian Sullivan, Vincent Liu, "Web Application security: A beginners guide, Tata McGraw Hill, 2012.
7. Charles P Fleeger, Shari Lawrence P Fleeger, "Security in Computing", Pearson Education, 2004.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=xMp5b8s67AU
2. https://www.youtube.com/watch?v=fRi-ub6so-Y
3. https://www.rohde-schwarz.com/in/applications/video-quality-testing-of-automotive-infotainment-devices-application-card_56279-533068.html
4. https://nptel.ac.in/courses/106106129
5. https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/cybersecurity%20in%20automotive%20mastering%20the%20challenge/cybersecurity-in-automotive-mastering-the-challenge.pdf

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL Certfication course : https://www.youtube.com/watch?v=9PZb6MlYGlo
2. Coursera Certfication course :https://www.coursera.org/learn/cyber-physical-systems-1

Noise Vibration Harshness			
Course Code	**21AU745**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To introduce the concepts of noise, vibration and harshness
2. To introduce the various measuring techniques
3. To identify interior, exterior and other sources of noise
4. To identify and measure the various sources of vibrations

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the definition of noise, sound, vibration and harshness
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teachers can devise innovative pedagogy to improve teaching-learning.

Module-1

Fundamentals of sound:

Definition of NVH, Vehicle noise - Direct sound generation mechanism: airborne sound; Indirect sound generation mechanism: structure-borne sound; Subjective response sound, basic attributes of sound, Measures of sound

Teaching-Learning Process	To define and introduce the concepts, suitable online videos could be used.

Module-2

Noise measurements and Instrumentation:

Measuring microphones, Sound level meter, time and frequency weighting, Sound spectra – Octave band analysis, Order analysis and waterfall plot, Various types of acoustic testing chambers, Sound power measurement from Sound pressure: Two- microphone probe for measuring; Sound power measurement from Sound Intensity

Teaching-Learning Process	The chapter focuses on the measuring instruments used in the measurement of noise. The introduction could be done using presentation slides. Further understanding could be done using actual instruments such as sound level meters and microphones.

Module-3

Vehicle Interior and Exterior noise:

Internal noise sources in vehicles such as engine noise; road noise; aerodynamic (wind) noise; brake noise; squeak, rattle and tizz noises; sound package solution to reduce the interior noise: acoustic isolation, acoustic absorption and damping material solutions; Exterior noise sources in vehicles such as air intake systems and exhaust systems; Tyre noise.

Sources of Vehicle Vibration:

Power train and Engine vibrations; driveline vibrations; chassis and suspension vibrations; Control strategies; Human response to vehicle vibrations, the concept of harshness; subjective and objective evaluation of vehicle harshness.

Teaching-Learning Process	Discussions on the types of noises could be done using Powerpoint slides and online videos.

Module-4

Vibration Isolation and Control:

Introduction to vibrations; Fundamentals of vibrations like frequency and time period and issues of vibrations in automobile, damping of vibrations; vibration isolation and absorption; design of a Vibration Absorbers, unconstrained and constrained layer damping treatment, add on dampers and stiffeners, Introduction to Active Vibration Control

Teaching-Learning Process	The initial discussions require a basic understanding of vibrations and their difference with noise. This could be achieved with Powerpoint slides

Module-5

Vibration Measurement and Instrumentation:

Definition of Modal Properties, Modal analysis theory, FE & Experimental modal analysis, Transducers and accelerometers Excitation sources Impact Excitation, Shaker excitation, Excitation signals, applications of Modal Analysis, laser based vibration measurements; analysis and presentation of vibration data.

Teaching-Learning Process	Powerpoint presentations and chalk & talk

Course outcome (Course Skill Set)

1. Understand and explain basics of Noise Vibration and Harshness.
2. Use different instruments and analyse the data to identify sources of noise and vibrations.
3. Understand /analyze, model and measure various sound and noise sources.
4. Identify the sources of vibration analyse the problem and suggest remedies for vibration damping.
5. Possess the knowledge of vibration measurement and instrumentation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Bies D. A. and Hansen C. H., Engineering Noise Control: Theory and Practice-, Spon Press, Taylor &Francis, NYUSA, 2003.
2. William W. Seto, Theory and Problems of Mechanical Vibrations, McGraw Hill International BookCo., Singapore, Illustrated Edition, 1964
3. S. S. Rao, Mechanical Vibrations, Pearson Education Inc., 5th Edition, 2010
4. S. Graham Kelly, Mechanical Vibrations, Schaum's Outline Series, Tata McGraw Hill Publishing Co.Ltd. SI Edition, 2000

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc19_me72/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. https://www.echosupply.com/blog/nvh-basics-the-science-of-sound

26.09.2022

Open Electives - II offered by the Department to other Department students
Energy Audit and Management

Course Code	21AU751	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To assess the importance of heat transfer
2. To understand the various available energy storage methods
3. To understand the various heat recovery methods
4. To review the basics of energy audit

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Review of the concepts of Thermodynamics, Fluid Mechanics and Heat Transfer, Need for energy storage, Grid balancing: Supply and demand concept for energy management. Heat transfer equipment- Heat exchangers, Steam plant

Teaching-Learning Process	Power Point presentation, YouTube videos,

Module-2

Energy storage Methods and systems: Thermal, Electrical and Mechanical energy storage methods and systems, Energy saving in IC engines and Gas turbines.

Direct Energy Conversion methods: Magneto-hydrodynamic (MHO) power generation, Thermionic power generation, Thermoelectric power generation, Fuel cells, Hydrogen energy system

Teaching-Learning Process	Power Point presentation, YouTube videos,

Module-3

Heat recovery systems: Incinerators, regenerators and boilers Energy Conservation: Methods of energy conservation and energy efficiency for buildings, air conditioning, heat recovery and thermal energy storage systems

26.09.2022

Teaching-Learning Process	Power Point presentation, YouTube videos,
Module-4	
Energy Management: Principles of Energy Management, Energy demand estimation, Organising and Managing Energy Management Programmes, Energy pricing	
Teaching-Learning Process	Power Point presentation, YouTube videos,
Module-5	
Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries, Economic Analysis: Scope, Characterization of an Investment Project and Case studies.	
Teaching-Learning Process	Power Point presentation, YouTube videos,

Course outcome (Course Skill Set)

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

1. Understand the basics of Energy efficiency by reviewing the importance of energy & heat transfer
2. understand the various efficient energy storage methods
3. understand the various heat recovery methods
4. Understand the basics of energy audit

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Energy Management audit & Conservation, De, B. K., Vrinda Publication, 2010, 2nd Edition.
2. Energy Management, Murphy, W. R., Elsevier, 2007, 1st Edition.
3. Energy Management Hand book, Doty, S. and Truner, W. C., Fairmont Press, 2009, 7th edition

Web links and Video Lectures (e-Resources):

1. International Energy Agency Website, (Link: https://www.iea.org/)
2. Indian Renewable Energy Development Agency Limited Website, (Link: Https://www.ireda.in)
3. Ministry of Power, GoI, Website, (Link: https://powermin.gov.in/).

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. https://nptel.ac.in/courses/108/106/108106022/
2. NPTEL Certfication course: https://nptel.ac.in/courses/108/106/108106022/
3. BEE Certfication course:

26.09.2022

26.09.2022

KNOWLEDGE MANAGEMENT			
Course Code	**21AU752**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To introduce the fundamentals of Knowledge Management
2. To expose to the concept of developing Knowledge repositories , to design a knowledge management system
3. Understand the socio cultural issues, Knowledge leadership and connect the leadership skills to ICT technology and management

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Knowledge Influences : Introduction, External influences on organizations, Changing nature of management, Types of organizations, Strategic management in organizations, Knowledge management, Knowledge management an emerging concept, Model of strategic knowledge management.

Introduction to Key Concepts : What is Management? Knowledge Management and business strategies, Knowledge intensive firms and Knowledge workers, Learning and Knowledge

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources,

Module-2

Management Knowledge Creation and Loss : Innovation dynamics and knowledge processes, characterizing innovation processes, innovation as an interactive process, knowledge creation and Nonaka, the social dynamics of innovation networking processes, forgetting and unlearning knowledge

Developing and Managing Knowledge Repositories : Effective knowledge repositories, mapping the content structure, repository quality control, case studies (not for examination)

26.09.2022

Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources,

Module-3

Design Knowledge Management System : Introduction, Structurepreserving design, Step 1: design system architecture, Step 2: identify target implementation platform, Step 3: specify architectural components, Step 4: specify application within architecture, design of prototypes, distributed architecture.

Socio-Cultural Issues : Introduction, significance of cross community knowledge processes, characterizing cross community knowledge processes, identity, knowledge, trust and social relations, classification of boundary types, facilitating/managing knowledge between communities

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources,

Module-4

Knowledge Leadership : Introduction, contributions of disciplines to Knowledge Leadership, the generic attributes of knowledge leader, specific knowledge leadership roles, leading knowledge teams, leading a knowledge network, recruiting and selecting knowledge leaders

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources,

Module-5

Information and Communication Technologies and Knowledge Management : Introduction, linking knowledge management and ICTs, objectivist perspectives on ICT – enabled knowledge management, practice based perspectives on ICT enabled KM, the importance of accounting for socio cultural factors in ICT enabled KM, debates regarding the role of ICTs in KM processes.

Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources,

Course outcome (Course Skill Set)

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

1. Understand the basics of Knowledge Management and key concepts
2. Differentiate between Knowledge creation and loss
3. Apply governing concepts of to develop Knowledge repositories and Manage after due analysis
4. Use the knowledge leadership skills to and link it to ICT and Knowledge management processes

26.09.2022

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Knowledge Management, Shelda Debowski, Wiley India, 2007.
2. Knowledge Management in Organizations, Donald Hislop, 2 nd Ed., Oxford University Press, 2009
1. Knowledge Engineering and Management, Guus Schreiber, et al, University Press India Pvt. Ltd., 2003
2. Knowledge Management - Classic and contemporary works,Daryl Morey, et. al., 2007.

Web links and Video Lectures (e-Resources):

4. https://www.youtube.com/watch?v=sVtMC3GkMr0
5. https://www.youtube.com/watch?v=oPnpfyAql7Q
6. https://www.youtube.com/watch?v=_dEkwRlyszo
7. https://www.youtube.com/watch?v=8CHyfH6xsjE
8. https://www.youtube.com/watch?v=1K3mUa0-1Js

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. NPTEL lecture videos,
2. Panel discussion with Industry and Academia experts
3. Watch You tube videos

Human Resource Management			
Course Code	21AU753	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. To develop a meaningful understanding of HRM theory, functions, and practices.
2. To apply HRM concepts and skills across various types of organizations.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Human Resource Management

Introduction, meaning, nature, scope of HRM. Importance and Evolution of the concept of HRM. Major functions of HRM, Principles of HRM, Organization of Personnel department, Role of HR Manager.

26.09.2022

Job Analysis: Meaning, process of job analysis, methods of collecting job analysis data, Job Description and Specification, Role Analysis.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HR department of nearby industry
Module-2	
Human Resource Planning: Objectives, Importance and process of Human Resource planning, Effective HRP **Recruitment:** Definition, Constraints and Challenges, Sources and Methods of Recruitment, New Approaches to recruitment. **Selection:** Definition and Process of Selection.	
Teaching-Learning Process	.Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HR department of nearby industry
Module-3	
Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation. **Training and development:** Training v/s development, Training v/s Education, Systematic Approach to Training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HR department of nearby industry
Module-4	
Performance Appraisal: Concept of Performance Appraisal, the Performance Appraisal process, Methods of Performance Appraisal, Essential Characteristic of an Effective Appraisal System. **Compensation:** Objectives of Compensation Planning, Job Evaluation, Compensation Pay Structure in India, Wage and Salary Administration, Factors Influencing Compensation Levels, Executive Compensation.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HR department of nearby industry
Module-5	
Employee Welfare: Introduction, Types of Welfare Facilities and Statutory Provisions. **Employee Grievances:** Employee Grievance procedure, Grievances management in Indian Industry. **Discipline:** Meaning, approaches to discipline, essential of a good disciplinary system, managing difficult employees.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HR department of nearby industry
Course outcome (Course Skill Set) At the end of the course the student will be able to : 1. Understand the importance, functions and principles Human Resource Management and process of Job analysis and the issues related to employee welfare, grievances and discipline. 2. Summarize the objectives of Human Resource planning, Recruitment and selection process 3. Analyse the job and choose right process involved in Placement, Training and development activities. 4. Make performance analysis and use an effective appraisal system and compensation planning. .	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Human Resource Management- Rao V.S.P, Excel books, 2010
2. Human Resource Management- Cynthia D. Fisher, 3/e, AIPD, Chennai
3. Human Resource Management: A South Asian Perspective, Snell, Bohlander &Vohra, 16th Rep., Cengage Learning, 2012
4. Human Resource Management- Lawrence S Kleeman, Biztantra, 2012
5. Human Resource Management- Aswathappa K, HPH
6. Human Resource Management- John M. Ivancevich, 10/e, McGraw Hill.
7. Human Resource Management in Practice- Srinivas R. Kandulla, PHI
8. Human Resource Management- Luis R Gomez-Mejia, David B. Balkin, Robert L Cardy, 6/e, PHI, 2010

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/122105020.
2. http://www.digimat.in/nptel/courses/video/110105069/L26.html
3. https://www.digimat.in/nptel/courses/video/122105020/L05.html
4. https://nptel.ac.in/courses/110105069

26.09.2022

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

4. Visit to nearby HR department and explore on HRM
5. Engage / organize invited lectures/ webinar from HR experts
6. Enrol for a certification course in NPTEL

Refrigeration and Air-Conditioning concepts			
Course Code	21AU754	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

1. Study the basic definitions of refrigerating and air conditioning systems
2. Understand the working principles and applications of different types of refrigeration systems and use of refrigerants
3. Learn about the psychrometry and related processes
4. Study the working of air conditioning systems and their applications

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

11. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
12. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
13. Show Video/animation films to explain functioning of various machines
14. Encourage collaborative (Group Learning) Learning in the class
15. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
16. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
17. Topics will be introduced in a multiple representation.
18. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
19. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
20. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

26.09.2022

Introduction to Laws of Thermodynamics : Joules experiments, Statement of the First law of thermodynamics, steady state-steady flow energy equation, important applications, Simple numerical problems on steady state-steady flow energy equation, Keivin –Planck &Clasius statement of Second law of Thermodynamics, PMM II and PMM I. equivalence of the two statements; **Concept of Heat Engines** and Heat pump, Simple numerical problems on heat engines/pump, Fundamentals Reverse Carnot cycle, block diagram of refrigerator & heat pump (numerical),	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab and nearby Refrigeration Plant/ Cold storage plant
Module-2	
Refrigerants Classification of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant: recovery reclaims, recycle and recharge.(No numerical Problems)	
Teaching-Learning Process	. Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab and nearby Refrigeration Plant/ Cold storage plant
Module-3	
Vapour Compression Refrigeration System(VCR): Comparison of Vapour Compression Cycle and Gas cycle, Vapour Compression Refrigeration system Working and analysis, Limitations, Superheat horn and throttling loss for various refrigerants, COP, Work and Refrigerating effect **Vapour absorption systems Introduction,** Working of simple vapour absorption system (VAR), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAR Actual VAR, LiBr absorption system, three fluid system (Electrolux refrigeration), applications of VAR, comparison between VCC and VAR. Simple numerical problems on basic VAR systems	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab and nearby Refrigeration Plant/ Cold storage plant
Module-4	
Psychrometry: Psychometric properties and terms, psychometric relations, Psychometric processes and its representation on psychometric chart, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF.	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab and nearby Refrigeration Plant/ Cold storage plant
Module-5	
Air Conditioning Systems Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning.(No numerical problems)	
Teaching-Learning Process	Chalk and Talk, PPT presentation, Video Lectures, web sources, visit to HT lab and nearby Refrigeration Plant/ Cold storage plant

26.09.2022

Course outcome (Course Skill Set)

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

1. Understand the basic working of refrigerating and air conditioning systems and identify their major components
2. Apply the basic concepts to evaluate the COP, Cooling and Heating coil capacities, Work requirements.
3. Learn about the psychrometry and related processes and identify the different property locations on a psychrometric chart
4. Compare the different refrigerants and choose the appropriate one for Refrigeration and Air conditioning systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

Books

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Arora C.P., Refrigeration and Air-conditioning, Tata Mc Graw –Hill, New Delhi, 2nd Edition, 2001.
3. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, Mc Graw - Hill, New Delhi 2nd edition, 1982.
4. Refrigeration and Air-Conditioning' by Manohar prasad
5. S C Arora& S Domkundwar, Refrigeration and Air-Conditioning Dhanpat Rai Publication

Web links and Video Lectures (e-Resources):

26.09.2022

1. http://nptel.ac.in/courses/112105128/# 2. http://www.digimat.in/nptel/courses/video/112107208/L35.html 3. https://www.youtube.com/watch?v=9uCeFhO8H40 4. https://www.youtube.com/watch?v=fcRR95Sy8_U 5. https://www.youtube.com/watch?v=j0xhc5juDak
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. VTU, E- learning, MOOCS, Open courseware 2. NPTEL Certification Course: https://nptel.ac.in/courses/112105129 3. NPTEL Certification Course: https://onlinecourses.nptel.ac.in/noc21_me85/preview 4. NPTEL Certification Coursehttps://onlinecourses.nptel.ac.in/noc19_me58/preview

26.09.2022

INTERNSHIP KTES AND GUIDELINES

01. Inter/Intra Institutional Internship)

The duration of the Internship is **03 weeks**

The students shall have to undergo a mandatory summer Internship-I/ **Inter/Intra Institutional Internship** in the intervening vocation of 2nd and 3rd semesters for regular students and for lateral entry students in the intervening vocation of 3rd and 4th semesters.

Each student of the Institute needs to have a Faculty Mentor. Faculty Mentor is a faculty from within the Institute who will **guide** students under him/her and keep track of the **progress** they are making at their Internship through proper communication from time to time. Faculty Mentor/Supervisors have to play active roles during the internship and a minimum of 20 students are to be supervised by each faculty mentor or as per the departmental strength.*(Supervisor/ Mentor's work can be treated as part of workload)*

Guidelines

Sl. No.	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Remarks
01	Taking part in Intra/ Inter-Institutional Workshop	Certificate	Program Head	
02	Inter/Intra-Institutional Training	Certificate	Program Head	
03	Working for Research Project	Certificate	Program Head	
04	Working for the organization of Technical Fest	Certificate	Program Head	
05	Working for Business festival	Certificate	Program Head	
06	Working for other events	Certificate	Program Head	
07	Working for the organization of the seminar	Certificate	Program Head/Coordinator	
08	Working for the organization of debate competition/ quiz competition etc… of department/college	Certificate	Program Head / Coordinator	
09	Working for cultural / curricular / co-curricular activities	Certificate	Coordinator	
10	Working for or Contributing in Incubation Cell/ Innovation Cell/Entrepreneurship cell/Institutional Innovation Council	Certificate	Cell In-Charge	
11	Learning at Departmental laboratory/Tinkering laboratory/Institution workshop/Idea laboratory	Certificate	Laboratory faculty in-charge	
12	Taking part in the Departmental/college level sport activities	Certificate	Departmental Coordinator/Physical Director	
13	Creating Environmental awareness for school students, conducting some quiz/essay completion to school students on environmental awareness.	Certificate	School Head/NSS coordinator of Institute	
14	Provide the knowledge and encourage the rural school / nearby school students for higher /Technical education (weekly 02 hours/80-90 hours total/20 activity points).	Certificate	Coordinator	
15	Creating awareness of good health and cleanliness	Certificate	Coordinator	

	among rural/ community people.			
16	Activities to Contribution to any national level initiative of the Government of India. For eg. Swachh Bharat Abhiyan etc.(weekly 02 hours/80-90 hours total/20 activity points).	Certificate	NSS Coordinator	
17	Provide the knowledge to rural people on reduction in Energy Consumption(Saving) (weekly 02 hours/80-90 hours total/20 activity points).	Certificate	NSS Coordinator	

02. Innovation/IPR/entrepreneurship based Internship)

The duration of the Internship is **04 Weeks**

The students shall have to undergo a mandatory summer Internship-I in the intervening vocation of the 4th and5th semesters.

Each student of the Institute needs to have a Faculty Mentor. Faculty Mentor is a faculty from within the Institute who will guide students under him/her and keep track of the progress they are making at their Internship provider's end through proper communication from time to time. Faculty Mentor/Supervisors have to play active roles during the internship and a minimum of 20 students are to be supervised by each faculty mentor or as per the departmental strength.*(Supervisor/ Mentor's work can be treated as part of work load)*

Guidelines

Sl. No.	Sub Activity Head	Proposed Document as Evidence	Evaluated by	Remarks
01	Participation in innovation-related completions for e.g. Hackathons etc.	Certificate	Faculty Mentor	
02	Working for the development of new product/ Business Plan/ registration of startup.	Certificate	Program Head	
03	Participation in all the activities of Institute's Innovation Council/ cell for e.g.: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc	Certificate	President/Convener of ICC	
04	Undergoing internship in state and central government organizations	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
05	Undergoing internship in Non-government organizations(NGOs)	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
06	Undergoing internship in Micro, Small and Medium Enterprises(MSME)	Evaluation Report	Faculty Mentor/TPO/Industrial Supervisor	
07	Online Internships of a reputed company	Evaluation Report	Faculty Mentor/Company Coordinator	
08	Operational Internships- NSQF /skill councils etc	Evaluation Report	Faculty Mentor/NSQF Supervisor	
09	Providing knowledge or educating the rural	Certificate	Faculty	

26.09.2022

	people on 100% Digitalized Money Transaction (weekly 02 hours/80-90 hours total/20 activity points)		Coordinator/NSS /NCC Head	
09	Preparing the actionable business proposal for enhancing the village income (2 hrs per week/80-90 hrs total/20 activity points)	Certificate	Faculty Coordinator/NSS /NCC Head	
10	Organizing and providing skills to rural population. (2 hrs per week/80-90 hrs total/20 activity points)	Certificate	Faculty Coordinator/NSS /NCC Head	
11	Provide the digitalized marking knowledge to rural people (weekly 02 hours/80-90 hours total/20 activity points).	Certificate	Faculty Coordinator/NSS /NCC Head	
12	Automation of Local Activities (2 hrs per week/80-90 hrs total/20 activity points)	Report	Faculty Coordinator	
13	Project work	Evaluation of Report	Faculty Coordinator	

26.09.2022

03. Research /Industry Internship

The duration of the Internship is **24 Weeks**

(Supervisor/ Mentor's work can be treated as part of work load)

At the End of the sixth / Seventh semester (in two cycles to accommodate all the students of the University)Research/Industrial Internship shall be carried out – Based on industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship.All thestudentsadmittedshallhavetoundergo a mandatory internship of**24weeks**duringthevacationofVI/VIIsemesters.

Guidelines

Research-internship StudentshavetotakeupresearchinternshipsatCentersofExcellence(CoE)/StudyCentersestablishedinthesame institute and/or out of the institute at reputed research organizations / Institutes. A research internship is intended to give you the flavor of current research going on a particular topic/s.

Industry internships: This is an extended period of work experience undertaken by students looking to supplement their degree with professional development. The student can take up **Interdisciplinary** Industry Internship. Students can undergo industry internships in recognized industries from local/within the state/within the country/abroad within the stipulated time as mentioned in the scheme The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.
University shall not bear any expenses incurred in respect of internship.

26.09.2022

EVALUATION THROUGH SEMINAR PRESENTATION/VIVAVOICE AT THE INSTITUTE The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report. Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students.