Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

1st to 8th Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
FIRST SEMESTER															
1	1	BS	GE/MTH	22ME101	Differential Equation, matrices and Statistics	T	3	1	0	4	4	30	20	50	3 Hrs
2	1	BS	GE/PHY	22ME102	Engineering Physics	T	3	0	0	3	3	30	20	50	3 Hrs
3	1	BS	GE/PHY	22ME103	Lab: Engineering Physics	P	0	0	2	2	1		60	40	
4	1	HS	GE/HUM	22ME104	Social Science	T	3	0	0	3	3	30	20	50	3 Hrs
5	1	BES	ME/ME	22ME105	Engineering Graphics	T	1	0	0	1	1	30	20	50	3 Hrs
6	1	BES	ME/ME	22ME106	Lab: Engineering Graphics	P	0	0	4	4	2		60	40	
7	1	BES	CT/CT	22ME107	Elements of AIML	T	3	0	0	3	3	30	20	50	3 Hrs
8	1	BES	ME/ME	22ME108	FAB Shop	P	0	0	2	2	1		60	40	
9	1	BES	ME/ME	22ME109	Machining Process	T	3	0	0	3	3	30	20	50	3 Hrs
10	1	BES	ME/ME	22ME110	Lab: Machining Process	P	0	0	2	2	1		60	40	
						TOTAL	**16**	**1**	**10**	**27**	**22**				
List of Mandatory Learning Course (MLC)															
1	1	HS	GE/T&P	MLC2121	YCAP1-Get Set Go	**A**	2	0	0	2	0				
2	1	BES	GE/CHE	GE2132	Environmental Science	**A**	2	0	0	2	0				
SECOND SEMESTER															
1	2	BS	GE/MTH	22ME201	Calculus and Vector	T	3	1	0	4	4	30	20	50	3 Hrs
2	2	BS	GE/CHE	22ME202	Engineering Chemistry	T	3	0	0	3	3	30	20	50	3 Hrs
3	2	BS	GE/CHE	22ME203	Lab: Engineering Chemistry	P	0	0	2	2	1		60	40	
4	2	HS	GE/HUM	22ME204	Professional Communication	T	3	0	0	3	3	30	20	50	3 Hrs
5	2	BES	CV/CV	22ME205	Engineering Mechanics	T	3	0	0	3	3	30	20	50	3 Hrs
6	2	BES	CV/CV	22ME206	Lab: Engineering Mechanics	P	0	0	2	2	1		60	40	
7	2	BES	EE/EE	22ME207	Basic Electrical and Electronics Engineering	T	3	0	0	3	3	30	20	50	3 Hrs
8	2	BES	IT/IT	22ME208	Programming for Problem Solving	T	3	0	0	3	3	30	20	50	3 Hrs
9	2	BES	IT/IT	22ME209	**Lab:** Programming for Problem Solving	P	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**25**	**22**				
List of Mandatory Learning Course (MLC)															
1	2	HS	GE/HUM	GE2131	Universal Human Value	**A**	2	0	0	2	0				
2	2	HS	GE/T&P	MLC2122	YCAP2 -Functional English	**A**	2	0	0	2	0				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : TA1-5 marks on Proctored Online Exam, TA2-12 marks on activitied decided by course teacher, TA3 - 3 marks on class attendance

TA = for Practical : MSPA will be 15 marks each**

		June 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
THIRD SEMESTER															
1	3	BS	GE/MTH	22ME301	Integral Transforms and Partial Differential Equations	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	3	HS	GE/HUM	22ME302	Fundamentals of Management and Economics	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	3	PC	ME/ME	22ME303	Material Science & Metallurgy	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	3	PC	ME/ME	22ME304	**Lab:-** Material Science & Metallurgy	**P**	0	0	2	2	1		60	40	
5	3	PC	ME/ME	22ME305	Manufacturing Process	**T**	3	0	0	3	3	30	20	50	3 Hrs
6	3	PC	ME/ME	22ME306	**Lab:-** Manufacturing Process	**P**	0	0	2	2	1		60	40	
7	3	PC	ME/ME	22ME307	Kinematics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	3	PC	ME/ME	22ME308	Mechanics of Materials	**T**	3	1	0	3	3	30	20	50	3 Hrs
9	3	PC	ME/ME	22ME309	**Lab:-** Mechanics of Materials	**P**	0	0	2	2	1		60	40	
10	3	PC	CV/EL	22ME310	Environmental Sustainability, Pollution and Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
						TOTAL	**21**	**1**	**6**	**27**	**24**				
List of Mandatory Learning Course (MLC)															
1	3	HS	GE/T&P	MLC2123	YCAP3 -	**A**	3	0	0	3	0				
2	3	HS	ME	MLC103	Computer Aided Design	**A**	2	0	0	2	0				
FOURTH SEMESTER															
1	4	BS	ME/ME	22ME401	Production Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	4	PC	ME/ME	22ME402	Design of Machine Elements	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	4	PC	ME/ME	22ME403	Engineering Thermodynamics	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	4	PC	ME/ME	22ME404	Fluid Mechanics	**T**	3	1	0	3	4	30	20	50	3 Hrs
5	4	PC	ME/ME	22ME405	**Lab:-** Fluid Mechanics	**P**	0	0	2	2	1		60	40	
6	4	PC	ME/ME	22ME406	Dynamics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	4	PC	ME/ME	22ME407	**Lab:-** Dynamics of Machines	**P**	0	0	2	2	1		60	40	
8	4	PC	ME/ME	22ME408	Metrology & Quality control	**T**	3	0	0	3	3	30	20	50	3 Hrs
9	4	PC	ME/ME	22ME409	**Lab:-** Metrology & Quality control	**P**	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**24**	**22**				
List of Mandatory Learning Course (MLC)															
1	4	HS	GE/T&P	MLC2124	YCAP4 -	**A**	3	0	0	3	0				
2	4	HS	ME	MLC104	MATLAB for Mechanical Engineering	**A**	2	0	0	2	0				

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		June 2022	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

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SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
FIFTH SEMESTER															
1	5	PC		22ME501	Heat Transfer	**T**	3	0	0	3	3	30	30	40	3
2	5	PC		22ME502	**Lab:-** Heat Transfer	**P**	0	0	2	2	1		60	40	
3	5	PC		22ME503	Fluid Machines	**T**	3	0	0	3	3	30	30	40	3
4	5	PC		22ME504	**Lab:-** Fluid Machines	**P**	0	0	2	2	1	0	60	40	
5	5	PC		22ME505	Operations Research Techniques	**T**	3	0	0	3	3	30	30	40	3
6	5	OE-I			**Open Elective - I ***	**T**	3	0	0	3	3	30	30	40	3
7	5	OE-II			**Open Elective - II ***	**T**	3	0	0	3	3	30	30	40	3
8	5	PC		22ME506	**Lab:-** Machine Drawing	**P**	0	0	2	2	1		60	40	
9	5	PC		22ME507	Mechanical measurement & Instrumentation	**T**	3	0	0	3	3	30	10	60	3
10	5	PC		22ME508	**Lab:-** Mechanical measurement & Instrumentation	**P**	0	0	2	2	1		60	40	
11	5	STR		22ME509	**Industrial training, Seminar & Report**	**P**	0	0	0	0	1		100		
					TOTAL FOURTH SEM		**18**	**0**	**8**	**26**	**23**				

Open Elective-I*

1	5	OE-I	ME	22ME531	OE I : Operations Research Techniques
2	5	OE-I	ME	22ME532	OE I : Automobile Engineering
3	5	OE-I	ME	22ME533	OE I : Control System Engineering
4	5	OE-I	ME	22ME534	OE I: Robotics and Subtractive Manufacturing

Open Elective-II*

1	5	OE-II	ME	22ME551	OE II : Total Quality Management
2	5	OE-II	ME	22ME552	OE II : Reliability Engineering
3	5	OE-II	ME	22ME553	OE II : Power Generation Engineering
4	5	OE-II	ME	22ME554	OE II : Project Evaluation & Management

List of Mandatory Learning Course (MLC)												
1	5	HS	T&P	MLC2125	YCAP5: YCCE Communication Aptitude Preparation	A	3	0	0	3	0	
2	5	HS	R&D	MLC125	Design Thinking	A	2	0	0	2	0	

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		June 2022	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

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(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
SIXTH SEMESTER															
1	6	PC	ME/ME	22ME601	CAD/CAM	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	6	PC	ME/ME	22ME602	CAD/CAM LAB	**P**	0	0	2	2	1		60	40	
5	6	PC	ME/ME	22ME603	Design of Mechanical Drives	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	6	PE	ME/ME		**Professional Elective -I**	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	6	PE	ME/ME		**Professional Elective -I LAB**	**P**	0	0	2	2	1		60	40	
6	6	PE	ME/ME		**Professional Elective II**	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	6	PE	ME/ME		**Professional Elective III**	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	6	OE-III	ME/ME		**Open Elective - III ****	**T**	3	0	0	3	3	30	20	50	3 Hrs
9	6	OE-IV	ME/ME		**Open Elective - IV ****	**T**	3	0	0	3	3	30	20	50	3 Hrs
10	6	PR	ME/ME	22ME604	PROJECT PHASE-1	**P**	0	0	2	2	1		60	40	
					TOTAL SIXTH SEM		**21**	**0**	**6**	**27**	**24**				

List of Professional Electives- I, II & III

Professional Electives-I

1	6	PE-I	ME	22ME611	PE I : Finite Element Methods
2	6	PE-I	ME	22ME612	PE I : **Lab:-** Finite Element Methods
3	6	PE-I	ME	22ME613	PE I :Industrial Fluid Power
4	6	PE-I	ME	22ME614	PE I : **Lab:-** Industrial Fluid Power
5	6	PE-I	ME	22ME615	PE I : I.C. Engines
6	6	PE-I	ME	22ME616	PE I : **Lab:-** I.C. Engines
7	6	PE-I	ME	22ME617	PE I : Advance Welding Techniques
8	6	PE-I	ME	22ME618	PE I : **Lab:** Advance Welding Techniques
9	6	PE-I	ME	22ME619	PE I : Computer Integrated Manufacturing
10	6	PE-I	ME	22ME620	PE I : **Lab:-** Computer Integrated Manufacturing
11	6	PE-I	ME	22ME621	PE I : Mechatronics
12	6	PE-I	ME	22ME622	PE I : **Lab:-** Mechatronics
13	6	PE-I	ME	22ME623	PE I :Computer Graphics and Solid Modelling
14	6	PE-I	ME	22ME624	PE I : **Lab:-** Computer Graphics and Solid Modelling
15	6	PE-I	ME	22ME625	PE I :Two Wheeler technology
16	6	PE-I	ME	22ME626	PE I : **Lab:-** Two Wheeler technology

Professional Electives-II

1	6	PE-II	ME	22ME631	PE II : Tool Design
2	6	PE-II	ME	22ME632	PE II : Additive Manufacturing
3	6	PE-II	ME	22ME633	PE II : Fuel Cell Technology
4	6	PE-II	ME	22ME634	PE II : Material Handling Systems
5	6	PE-II	ME	22ME635	PE II : Reliability Engineering
6	6	PE-II	ME	22ME636	PE II : Bio- Mechanics
7	6	PE-II	ME	22ME637	PE II :Composites
8	6	PE-II	ME	22ME638	PE II : Data Analytics In Mechanical Engineering
9	6	PE-II	ME	22ME639	PE II : Advanced Manufacturing Techniques

Professional Electives-III

1	6	PE-III	ME	22ME651	PE III : Artificial Intelligence
2	6	PE-III	ME	22ME652	PE III : Design for Manufacturing & Assembly
3	6	PE-III	ME	22ME653	PE III : Renewable Energy System
4	6	PE-III	ME	22ME654	PE III : Plastics and Composite
5	6	PE-III	ME	22ME655	PE III : Tribology in Manufacturing
6	6	PE-III	ME	22ME656	PE III : Finance & Cost Management
7	6	PE-III	ME	22ME657	PE III : Maintenance Management

Open Electives-III**

1	6	OE-III	ME	22ME671	OE III : Operations Research Techniques
2	6	OE-III	ME	22ME672	OE III : Automobile Engineering
3	6	OE-III	ME	22ME673	OE III : Robotics and Subtractive Manufacturing
4	6	OE-III	ME	22ME674	OE III : Control System Engineering

Open Electives-IV**

1	6	OE-IV	ME	22ME691	OE IV : Total Quality Management
2	6	OE-IV	ME	22ME692	OE IV : Reliability Engineering
3	6	OE-IV	ME	22ME693	OE IV : Power Generation Engineering
4	6	OE-IV	ME	22ME694	OE IV : Project Evaluation & Management

List of Mandatory Learning Course (MLC)

1	6	HS		MLC126	**YCAP6 :**		**A**	3	0	0	3	0	

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		June 2022	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

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SoE No.
22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
SEVENTH SEMESTER															
1	7	PC	ME/ME	22ME701	Automation In Production	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	7	PC	ME/ME	22ME702	**Lab:-** Automation In Production	**P**	0	0	2	2	1		60	40	
5	7	PE	ME/ME		**Professional Elective IV**	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	7	PE	ME/ME		**Professional Elective IV-LAB**	**P**	0	0	2	2	1		60	40	
4	7	PE	ME/ME		**Professional Elective V**	**T**	3	0	0	3	3	30	20	50	3 Hrs
6	7	PE	ME/ME		**Professional Elective VI**	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	7	PE	ME/ME		**Professional Elective VII**	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	7	PR	ME/ME	22ME703	Project Phase-II	**P**	0	0	0	10	5		60	40	
9	7	STR	ME/ME	22ME704	Campus Recrutment Training (CRT)	**P**	0	0	0	0	2		100		
					TOTAL SIXTH SEM		**15**	**0**	**4**	**29**	**24**				

List of Professional Electives- IV, V, VI & VII

Professional Electives-IV

1	7	PE-IV	ME	22ME711	PE IV : CFD
2	7	PE-IV	ME	22ME712	PE IV : **Lab**:- CFD
3	7	PE-IV	ME	22ME713	PE IV : Referigeration Air conditioning and Cryogenics
4	7	PE-IV	ME	22ME714	PE IV : **Lab**:- Referigeration Air conditioning and Cryogenics
5	7	PE-IV	ME	22ME715	PE IV : Vehicle Engineering
6	7	PE-IV	ME	22ME716	PE IV : **Lab**:- Vehicle Engineering
7	7	PE-IV	ME	22ME717	PE IV : Solar Energy and It'S Utilisation
8	7	PE-IV	ME	22ME718	PE IV : **Lab**:- Solar Energy and It'S Utilisation
9	7	PE-IV	ME	22ME719	PE IV : CNC & Robotics
10	7	PE-IV	ME	22ME720	PE IV : **Lab**:- CNC & Robotics
11	7	PE-IV	ME	22ME721	PE IV : Electric and Hybrid Vehicle
12	7	PE-IV	ME	22ME722	PE IV : **Lab**:- Electric and Hybrid Vehicle
13	7	PE-IV	ME	22ME723	PE IV : Earth Moving Equipments
14	7	PE-IV	ME	22ME724	PE IV : **Lab**:- Earth Moving Equipments

Professional Electives-V

1	7	PE-V	ME	22ME731	PE V : Machine Learning in Manufacturing
2	7	PE-V	ME	22ME732	PE V : Project Evaluation & Management
3	7	PE-V	ME	22ME733	PE V: Thermal Engineering Systems
4	7	PE-V	ME	22ME734	PE V : Surface Engineering
5	7	PE-V	ME	22ME735	PE V : Synthesis of Mechanism
6	7	PE-V	ME	22ME736	PE V : Turbines
7	7	PE-V	ME	22ME737	PE V : Control System Engineering
8	7	PE-V	ME	22ME738	PE V: Machine Tool Design

Professional Electives-VI

1	7	PE-VI	ME	22ME751	PE VI: Stress Analysis
2	7	PE-VI	ME	22ME752	PE VI : Product Design and Development
3	7	PE-VI	ME	22ME753	PE VI : Power Plant Engineering
4	7	PE-VI	ME	22ME754	PE VI : IOT in ME
5	7	PE-VI	ME	22ME755	PE VI : Design of Experiments and Taguchi Methods
6	7	PE-VI	ME	22ME756	PE VI : Non Destructive testing
7	7	PE-VI	ME	22ME757	PE VI: Computetional Methods in ME

Professional Electives-VII

1	7	PE-VII	ME	22ME771	PE VII: Engineering failure Analysis
2	7	PE-VII	ME	22ME772	PE VII: Vibration
3	7	PE-VII	ME	22ME773	PE VII: Gas Dynamics and Jet Propulsion
4	7	PE-VII	ME	22ME774	PE VII: Industry 4.0
5	7	PE-VII	ME	22ME775	PE VII: MEMS
6	7	PE-VII	ME	22ME776	PE VII: AI in Manufacturing
7	7	PE-VII	ME	22ME777	PE VII : Lean Manufacturing and Six Sigma

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		June 2022	**1.00**
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Applicable for AY 2022-23 Onwards

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

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SoE No.
22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
Eighth Semester															
1	**8**	**STR**	ME	22ME801	Industrial Internship	**P**	0	0	12	12	3		60	40	
2	**8**	**STR**	ME	22ME802	Extra Curricular Activity Evaluation	**P**	0	0	0	0	2		100		
					TOTAL EIGHTH SEM		**0**	**0**	**12**	**12**	**5**				
					GRAND TOTAL		**127**	**4**	**58**	**197**	**166**				

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Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

1st Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

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(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SoE No. 22ME-101

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
FIRST SEMESTER															
1	1	BS	GE/MTH	22ME101	Differential Equation, matrices and Statistics	T	3	1	0	4	4	30	20	50	3 Hrs
2	1	BS	GE/PHY	22ME102	Engineering Physics	T	3	0	0	3	3	30	20	50	3 Hrs
3	1	BS	GE/PHY	22ME103	Lab: Engineering Physics	P	0	0	2	2	1		60	40	
4	1	HS	GE/HUM	22ME104	Social Science	T	3	0	0	3	3	30	20	50	3 Hrs
5	1	BES	ME/ME	22ME105	Engineering Graphics	T	1	0	0	1	1	30	20	50	3 Hrs
6	1	BES	ME/ME	22ME106	Lab: Engineering Graphics	P	0	0	4	4	2		60	40	
7	1	BES	CT/CT	22ME107	Elements of AIML	T	3	0	0	3	3	30	20	50	3 Hrs
8	1	BES	ME/ME	22ME108	FAB Shop	P	0	0	2	2	1		60	40	
9	1	BES	ME/ME	22ME109	Machining Process	T	3	0	0	3	3	30	20	50	3 Hrs
10	1	BES	ME/ME	22ME110	Lab: Machining Process	P	0	0	2	2	1		60	40	
						TOTAL	**16**	**1**	**10**	**27**	**22**				
List of Mandetory Learning Course (MLC)															
1	1	HS	GE/T&P	MLC2121	YCAP1-Get Set Go	**A**	2	0	0	2	0				
2	1	BES	GE/CHE	GE2132	Environmental Science	**A**	2	0	0	2	0				
SECOND SEMESTER															
1	2	BS	GE/MTH	22ME201	Calculus and Vector	T	3	1	0	4	4	30	20	50	3 Hrs
2	2	BS	GE/CHE	22ME202	Engineering Chemistry	T	3	0	0	3	3	30	20	50	3 Hrs
3	2	BS	GE/CHE	22ME203	Lab: Engineering Chemistry	P	0	0	2	2	1		60	40	
4	2	HS	GE/HUM	22ME204	Professional Communication	T	3	0	0	3	3	30	20	50	3 Hrs
5	2	BES	CV/CV	22ME205	Engineering Mechanics	T	3	0	0	3	3	30	20	50	3 Hrs
6	2	BES	CV/CV	22ME206	Lab: Engineering Mechanics	P	0	0	2	2	1		60	40	
7	2	BES	EE/EE	22ME207	Basic Electrical and Electronics Engineering	T	3	0	0	3	3	30	20	50	3 Hrs
8	2	BES	IT/IT	22ME208	Programming for Problem Solving	T	3	0	0	3	3	30	20	50	3 Hrs
9	2	BES	IT/IT	22ME209	**Lab:** Programming for Problem Solving	P	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**25**	**22**				
List of Mandetory Learning Course (MLC)															
1	2	HS	GE/HUM	GE2131	Universal Human Value	**A**	2	0	0	2	0				
2	2	HS	GE/T&P	MLC2122	YCAP2 -Functional English	**A**	2	0	0	2	0				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : TA1-5 marks on Proctored Online Exam, TA2-12 marks on activitied decided by course teacher, TA3 - 3 marks on class attendance

TA = for Practical : MSPA will be 15 marks each**

		June 2022	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

I SEMESTER

22ME101: Differential Equation, matrices & Statistics

Course Outcomes
Upon successful completion of the course the students will be able to
1. Use appropriate Methods to solve first order and higher order differential equations and apply it to find solutions of engineering problems.
2. Use Matrix method to solve linear system of equations, evaluate eigen values - eigen vectors and its applications.
3. Make use of probability distributions to solve real life problems.
4. Inspect scientific data, use proper curve fitting and find correlation, regression of variables.

Unit I: Differential Equations I	**(7 Hrs.)**
Linear differential equations of first order and first degree, Differential equation reducible to linear form, Exact differential equations (excluding the case of integrating factor) and their applications to various fields. **(Contemporary Issues related to Topic)**	
Unit II: Differential Equations II	**(7 Hrs.)**
Higher order linear differential equations with constant coefficients, Complementary functions and Particular Integral for different cases, Method of variation of parameters, Examples on application to various fields. **(Contemporary Issues related to Topic)**	
Unit III: Differential Equations III	**(6 Hrs.)**
Cauchy's homogeneous linear differential equations, Legendre's linear differential equation, Applications of differential equations to various field (only up to second order). **(Contemporary Issues related to Topic)**	
Unit IV: Matrices	**(6 Hrs.)**
Rank of a matrix, Consistency of system of equations using rank, Characteristics equations, Eigen values and Eigen vectors, Cayley Hamilton Theorem (without proof) statement and verification, Sylvester's theorem-statement and its application. **(Contemporary Issues related to Topic)**	
Unit V: Probability Distributions	**(7 Hrs.)**
Conditional probability, Baye's theorem, Binomial, Poisson, Normal distributions. **(Contemporary Issues related to Topic)**	
Unit VI: Statistics	**(6 Hrs.)**
Fitting of straight line, $y = a + bx$, a parabola $y = a + bx + cx^2$, exponential curves and power curves by method of least squares; Lines of regression and correlation; Rank correlation. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Erwin Kreyzig, Advance Engineering Mathematics, 6th Edition, John Wiley and Sons, INC.
2.	H.K. Dass, Engineering Mathematics, 11th revised edition, S. Chand, Delhi.
3.	H.K. Dass, Advanced Engineering Mathematics, 8th revised edition, S. Chand, Delhi.
4.	Dr. B.S. Grewal, Higher Engineering Mathematics, 42th edition, Khanna Publishers.
5.	P.N.Wartikar and J.N.Wartikar, Applied Mathematics, 4th Edition, Vidyarthi GrihaPrakashan.

Reference Books:	
1.	G B Thomas and R L Finney, Calculus and Analytical Geometry, 9th edition, Addison-Wesley, 1999.
2.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, 10th edition, Laxmi Prakashan.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Mathematics%20and%20Humanities/

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/111103070
2.	https://onlinecourses.nptel.ac.in/noc19_ma28/preview
3.	https://nptel.ac.in/courses/111/106/111106100/

I SEMESTER
22ME102: Engineering Physics

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Correlate fundamental of quantum mechanics to solve problems dealing with quantum particle. 2. Justify the characteristics of semiconductor materials in terms of crystal structure, charge carriers and energy bands. 3. Assess the fundamentals of interference and their significance in optical measurements. 4. Illustrate working principle of lasers and optical fibers for their use in the field of industry. 5. Identify and analyze the fundamentals of ultrasonic and acoustic waves and their applications in technology.

Unit:1 Quantum Mechanics	**(7 Hrs.)**
Wave particle duality, de-Broglie's hypothesis, Wave packet, Phase and Group velocity, Heisenberg's uncertainty principle and its applications, Wave function (ψ), Max Born's interpretation, Schrödinger's wave equations and it's applications. **(Contemporary Issues related to Topic)**	
Unit II: Basics of Semiconductors	**(7 Hrs.)**
Formation of energy bands in solids, valence and conduction band, Classification, Pure and doped semiconductors, Law of mass action, Conduction mechanism, Hall effect. Photovoltaic cell (Solar Cell). **(Contemporary Issues related to Topic)**	
Unit III: Wave Optics	**(7 Hrs.)**
Interference: Thin film interference, Wedge shaped film, Newton's rings, Applications of thin film interference, Antireflection coatings. **(Contemporary Issues related to Topic)**	
Unit IV: Laser	**(6 Hrs.)**
Coherence, Interaction of radiation with matter, Population Inversion and Optical resonance cavity , Three and four level laser, Ruby laser, He-Ne laser, Properties and engineering applications of laser. **(Contemporary Issues related to Topic)**	
Unit V: Fibre Optics	**(6 Hrs.)**
Principle, structure and classification, Acceptance angle, Numerical aperture, Losses in optical fibres, Applications as sensor. **(Contemporary Issues related to Topic)**	
Unit VI: Ultrasonic and Acoustics	**(7 Hrs.)**
Ultrasonic waves: Production and detection, Properties of ultrasonic waves, Determination of velocity of ultrasonic waves, Applications. **Acoustics :** Characteristics of sound, Weber Fechner Law, Sound Intensity (Decibel) and Pressure Level, Sound reflection, Sound absorption, Sabine's Formula (Qualitative), Factors affecting the architectural acoustics and their remedies, Acoustic quieting. **(Contemporary Issues related to Topic)**	
Total Lecture	**40 Hours**

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Textbooks:	
1.	M. N. Avadhanulu, P. G. Kshirsagar, A Textbook of Engineering Physics, Revised 14th Edition, S. Chand & Company, 2014.
2.	Hitendra K Malik , A K Singh , Engineering Physics, 2nd Edition, Tata McGraw Hill Education Private Limited, 2015.

Reference Books:	
1.	Sanjay D Jain, Girish G Sahasrabudhe, Engineering Physics, 2nd Edition, Universities Press, 2015.
2.	P K Palanisamy, Engineering Physics, Revised Edition, SCITECH, 2015.
3.	David Halliday, Robert Resnick and Jerle Walker, Fundamentals of Physics, 10th edition, John-Wiley India, 2013.
4.	Arthur Beiser, Concept of Modern Physics, 6th edition , Tata McGraw - Hill Education, 2002.
5.	Subramanyam, Brijlal, M N Avadhanulu, Text Book of Optics, S. Chand & Company, 2006.
6.	S. O. Pillai, Solid State Physics, 9th edition, New Edge International Publishers, 2021

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Physics/Eisberg%20&%20Resnick%20-%20Quantum%20Physics.pdf
2	chrome-http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Physics/2016_Book_ThePhysicsOfSemiconductors.pdf
3	chrome-http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Physics/Dekker%20-%20Solid%20State%20Physics.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/122/107/122107035/
2.	https://nptel.ac.in/courses/122104016
3.	https://freevideolectures.com/course/3531/engineering-physics-i

I SEMESTER
22ME103: Lab: Engineering Physics

Course Outcomes
Upon successful completion of the course the students will be able to
1. Correlate fundamental of quantum mechanics to solve problems dealing with quantum particle.
2. Justify the characteristics of semiconductor materials in terms of crystal structure, charge carriers and energy bands.
3. Assess the fundamentals of interference and their significance in optical measurements.
4. Illustrate working principle of lasers and optical fibers for their use in the field of industry.
5. Identify and analyze the fundamentals of ultrasonic and acoustic waves and their applications in technology.

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Determination of Planck's constant.
2	To study V-I characteristics of a Tunnel Diode.
3	Determination of Hall coefficient and density of charge carriers using Hall effect.
4	Dependence of Hall coefficient on temperature.
5	To study of V-I characteristics of a semiconductor diode (Germanium and Silicon) in forward and reverse bias mode.
6	To determine the forbidden energy gap of a semiconductor by studying the temperature variation of its resistivity using four probe method.
7	Determination of Band gap in a semiconductor using reverse biased p-n diode.
8	To study of V-I characteristics of a LED.
9	To determine the radius of curvature of Plano-convex lens by using Newton's Rings apparatus.
10	To determine the thickness of thin paper using Air Wedge arrangement.
11	Determination of wavelength of laser using diffraction grating.
12.	Determination of divergence of laser beam.
13.	Determination of acceptance angle and numerical aperture of a given optical fibre.
14.	Determination of the velocity of Ultrasonic waves in a non –electrolytic liquid by ultrasonic interferometer.

I SEMESTER

22ME104: Social Science

Course Outcomes
Upon successful completion of the course the students will be able to
1. Explain the basic concepts of social sciences.
2. Describe the development of various Civilizations and their culture.
3. Explain the basic idea of Constitution of India and aware about their rights & Duties.
4. Analyze the Impact of Industrialization on Society and discuss the Fundamental Concepts of Society.

Unit I: Social Sciences & Its Utility	**(6 Hrs.)**
Meaning & Scope of Social Science, General Utility of Social Sciences to Engineers, Applied Humanities, Social Engineering, Society its types & Characteristics. **(Contemporary Issues related to Topic)**	
Unit II: Human Civilization	**(7 Hrs.)**
Development of human civilization with specific reference to monumental studies of engineering skill, Ancient Indian Civilization:- a) Indus Valley Civilization b) Vedic Civilization, c) Indian Art & Architecture. **(Contemporary Issues related to Topic)**	
Unit III: Fundamental Concept in Social Science	**(7 Hrs.)**
Social Structure and Social System, Socialization, Social Control and Social Change, Culture: Characteristics and Features. **(Contemporary Issues related to Topic)**	
Unit IV: Introduction to Constitution of India	**(7 Hrs.)**
Significance of Preamble, Fundamental Rights and Duties, Directive principles of state policy. Federal System Concept of industrial Democracy. **(Contemporary Issues related to Topic)**	
Unit V: Industrial Organization & Society	**(6 Hrs.)**
Industrialization and its impact on society, Selection, Training & Motivation of workers, Industrial Psychology, Industrial sociology, Work Organization, Power, Authority and Status system. **(Contemporary Issues related to Topic)**	
Unit VI: Industrial Management	**(6 Hrs.)**
Labour Union Organization, Discipline in Industry, Labour Turnover, Industrial Fatigue of workers, Health and Safety of Workers. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

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Textbooks:	
1.	S. Shabbir & Sheikh, A New Look Into Social Sciences, S.Chand , New Delhi,1993.
2.	C N Shankar Rao, Sociology Principles of Sociology With An Introduction To Social Thought, S. Chand, New Delhi, 2010.
3.	O P Khanna, Industrial Engineering And Management, Dhanpat Rai Publication, New Delhi, 2010.
4.	Dr. G. N. Nimbarte, Social Science, Sankalp Publications, Nagpur.

Reference Books:	
1.	C. N. Shankar Rao, Sociology: Principal of Sociology with an introduction to social thought, Publication: S. Chand, New Delhi.
2.	O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publication, New Delhi.
3.	Reader's Digest Vanished Civilizations, The Reader's Digest Association Limited, New York.
4.	Constitution of India: Dr B. R. Ambedkar: Government of India, Government of India.
5.	B. L. Kayastha, Recent trends in Humanities and Social Sciences, 1st Ed., Akinik Publications, New Delhi.

MOOCs Links and additional reading, learning, video material	
1.	https://mobidrive.com/sharelink/r/4I2bDsxN9YrVI03vMZaInJ5VBpojBmR9EqKv7nin9pkN
2.	https://mobidrive.com/sharelink/r/4I2bDsxN9YrVI03vMZaInJ2sUn37wK4V3CpGhemYRKnz

I SEMESTER

22ME105: Engineering Graphics

Course Outcomes :
Upon successful completion of the course the students will be able to
1. Construct orthographic drawing and isometric drawing of a given object
2. Evaluate Projections of various One Dimensional, Two dimensional, Three dimensional objects
3. Develop the lateral surfaces of various solids, their section and intersection.
4. Practice the use of software tools used for Two dimensional drawings.

Unit I: Theory of Orthographic Projections:	**(3 Hrs.)**
Introduction, Quadrant system, Theory of orthographic projection, Projection method and principal planes, First and Third angle projections. **(Contemporary Issues related to Topic)**	
Unit II: Theory of Isometric Projections:	**(2 Hrs.)**
Theory of isometric projection, Method for drawing isometric views, Different problems on isometric projections. **(Contemporary Issues related to Topic)**	
Unit III: Lines:	**(2 Hrs.)**
Projection of points, Projection of lines, True lengths and inclinations, apparent lengths and inclinations, various positions of lines in different quadrants, Traces of lines, projection of line on auxiliary plane. **(Contemporary Issues related to Topic)**	
Unit IV: Planes and Solids:	**(4 Hrs.)**
Projection planes: (Polygonal Lamina, Circular Lamina), Projection of Perpendicular planes and oblique planes. Auxiliary views (Auxiliary planes) Projection of Solids :(Inclined to One Plane Only) - Polyhedra (Regular and Irregular Polyhedra), Solids of Revolution. **(Contemporary Issues related to Topic)**	
Unit V: Section of Solids and Development of Surfaces:	**(2 Hrs.)**
Types of Section planes, Sectional top view, True shape. Development of different solids using Radial line and parallel line methods. **(Contemporary Issues related to Topic)**	
Unit VI: Intersection of Surfaces of solids:	**(2 Hrs.)**
Intersection between similar solids, Intersection between dissimilar solids, Lines and Curves of Intersection. **(Contemporary Issues related to Topic)**	
Total Lecture	**15 Hours**

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Textbooks:	
1.	D.M. Kulkarni, A. P. Rastogi and A. K. Sarkar , Engineering Graphics with AutoCAD PHI learning Pvt. Ltd., Revised Edition(2014),
2.	N. D. Bhatt ,Engineering Drawing Charotar Publishing House Pvt. Ltd, 53 rd Edition 2017

Reference Books:	
1.	D. A. Jolhe Engineering Drawing , Tata McGraw Hill Publications , 2008,
2.	K. L. Narayana & P. Kannaiah , Engineering Drawing SciTech Publication , 2010
3.	R. K. Dhawan Engineering Drawing S. Chand Publication Multicolor revised edition 2015

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	Intranet on address 172.16.1.10. data/CCC/software / AutoCAD Software Setup.

MOOCs Links and additional reading, learning, video material	
1.	https://youtube.com/playlist?list=PLLy_2iUCG87Bw9XPfEF3r3EW5UlAOv8iz
2.	https://nptel.ac.in/courses/112105294

I SEMESTER

22ME106: Lab : Engineering Graphics

Course Outcomes
Upon successful completion of the course the students will be able to
1. Construct orthographic drawing and isometric drawing of a given object
2. Evaluate Projections of various One Dimensional, Two dimensional, Three dimensional objects
3. Develop the lateral surfaces of various solids, their section and intersection**.**
4. Practice the use of software tools used for Two dimensional drawings.

Practical's to be performed from the list as below

SN	**Experiments based on**	**No.of Practical's**
1	Introduction of AutoCAD Basic Commands	02
2	Orthographic Projection	03
3	Isometric Projection	03
4	Projection of Straight Line	03
5	Projection of Planar Surface	03
6	Projection of Solid	03
7	Section and Development of Solid	04
8	Intersection of Surfaces	03
9	Drawing Sheet 1: Convention for various lines, Dimensioning and Orthographic Projection	02
10	Drawing Sheet 2: Projection of line, planar surface or solid. (Any one)	02
	Total Practical's	**28 Hours**

I SEMESTER

22ME107: Elements of AIML

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Develop an understanding what is involved in AIML. 2. Understand learning algorithms of AIML. 3. Understand the deep learning. 4. Apply the knowledge for the selection of tool and languages for problem solving 5. Understand the use of AIML for real world problems.

Unit I: Introduction to Artificial Intelligence	**(7 Hrs.)**
What Is Artificial Intelligence? History, AI and Society, Agents and Knowledge based systems, Components of AI. **(Contemporary Issues related to Topic)**	
Unit II: Propositional Logic	**(7 Hrs.)**
Propositional Logic, First order logic, limitations of logic, Search, Games and Problem Solving, Reasoning with Uncertainty. **(Contemporary Issues related to Topic)**	
Unit III: Machine Learning	**(7 Hrs.)**
Supervised learning, Unsupervised learning, Reinforcement learning: Model based learning, Regression, Decision trees, Linear Discrimination, Kernel Machines and Graphical Models. **(Contemporary Issues related to Topic)**	
Unit IV: Artificial Neural Networks and Deep Learning	**(7 Hrs.)**
Biological neural network, Artificial neural network, Hopfield network, Neural Associative memory, Linear networks, Backpropogation algorithm, Support Vector Machines, Basics of deep learning. **(Contemporary Issues related to Topic)**	
Unit V: Introduction to Platforms, Tools, Frameworks and languages for AIML	**(6 Hrs.)**
Top AIML Softwares: Salesforce Einstein, IBM Watson, Deep Vision, Cloud Machine Learning Engine, Azure Machine Learning Studio, Nvidia Deep Learning AI, Playment; Machine learning tools: TensorFlow, Amazon Machine Learning, Accord.NET, Apache Mahout, Shogun; Programming languages: Python, R, Java, Julia, C/C++, Others: Scikit Learn, Theano, Caffe, MxNet, Keras, PyTorch, CNTK, Auto ML, OpenNN, H20: Open Source AI Platform, Google ML Kit. **(Contemporary Issues related to Topic)**	
Unit VI: Applications of AI and ML	**(6 Hrs.)**
Working with software based AI Applications, Working with AI in hardware Applications, Health, Banking and Finance, Automobile, Surveillance, Social Media, Education, Space, etc. **(Contemporary Issues related to Topic)**	
Total Lecture	**40 Hours**

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Textbooks:	
1.	Wolfgang Ertel, "Introduction to Artificial Intelligence" 2nd Edition, UTiCS, Springer
2.	Ethem Alpaydın ,"Introduction to Machine Learning" 3rd Edition,The MIT Press, Cambridge, Massachusetts London, England.

Reference Books:	
1.	John Paul Mueller, Luca Massaron John Wiley & Sons ,"Artificial Intelligence for Dummies" First, 2018
2.	Steven W. Knox,Wiley" Machine Learning A Concise Introduction" First, 2018

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=kwSTs0QVRfU
2.	https://www.youtube.com/watch?v=GHpchgLoDvI&list=PLp6ek2hDcoNB_YJCruBFjhF79f5ZHyBuz
3.	https://nptel.ac.in/courses/106105077

I SEMESTER
22ME108: FAB Shop

Course Outcomes:
Upon successful completion of the course the students will be able to: 1. Interpret the general safety/precautions on shop floor; identify and use the different materials, machines and measuring and cutting tools. 2. Practice on manufacturing of components using workshop trades including fitting, plumbing, carpentry, smithy/foundry and welding, etc. 3. Demonstrate practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes. 4. Produce simple/small devices of their interest for project/product development or research purpose.

Sr.No	Experiments based on	CO	Level
1	Study and demonstration of safety norms, unfair practices, meaning of different signs/symbols and use of fire extinguishers	I	L-II
2	Study and demonstration of different materials, devices/machines, cutting and measuring devices used in fitting, plumbing, carpentry, smithy/foundry, welding and machining shop.	I	L-II
3	Create simple job/part/pattern in fitting, plumbing, carpentry, smithy/foundry and welding shop.	II	L-III
4	Elaborate the created job/part/pattern with proper justification of its dimensional accuracies and tolerances.	III	L-III
5	Case study: To prepare simple/small models (Group Activity)	IV	L-III
6	**Demonstration of Advance Machining Facility:** (With manufacturing of sample job on any one machine)	I	L-II
	a) Lathe, Drilling, Milling, Shaper, Press etc **OR**		
	b) CNC Trainer Lathe/Milling Machines **OR**		
	c) CNC Router **OR**		
	d) EDM		

Text books	
1	Workshop Technology - Part I,Chapman W.A.JFifth edition CBS Publishers
2	Elements of Workshop Technology, (Vol-I), S.K.Hajra Choudhary,A.K.Hajra Choudhary,Nirjhar Roy, Media Promoters & Publishers Pvt Ltd
3	Workshop Technology (Volume-II) Hajra Choudhary 2nd Edition (2012) The McGraw-Hill Companies
4	Manufacturing Technology (Metal Cutting & Machine Tools) P N Rao 2nd Edition (2009) The McGraw-Hill Companies
5	A Course in Workshop Technology , Vol-I, B S Raghwanshi, Dhanpat Rai & Company
6	A Text Book on Workshop Technology by R S Khurmi & J K Gupta, S K Chand & Co
7	Workshop Manual by P Kannaiah & K L Narayana, SCITECH Publications

Reference Books	
1	Manufacturing Engineering & Technology S Kalpakjian & SR Schmid 1st Edition (2009) Pearson Education Canada
2	Technology of machine Tools Krar & Oswald 1st Edition (1984) Gregg Division, McGraw-Hill
3	Manufacturing Processes M Begman 1st Edition (1974) Ballinger Pub. Co
4	Manufacturing Science Ghosh & Malik 2nd Edition (2010) East West

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042

MOOCs Links and additional reading, learning, and video material	
1	https://nptel.ac.in/courses/112/103/112103280/
2	https://nptel.ac.in/courses/106/106/106106179/
3	https://nptel.ac.in/courses/127/105/127105007/

I SEMESTER
22ME109: Machining Process

Course Outcomes:
Upon successful completion of the course the students will be able to
1. Evaluate among various cutting tool materials and tool geometries.
2. Examine the different processes and machine tools for cylindrical surface machining.
3. Demonstrate the various machining processes and conditions for flat surface machining using SPCT.
4. Examine the machining processes for flat surfaces marching using MPCT.

Unit:1	**Mechanics of Machining and Machinability**	**7 Hours**
Introduction to machining, geometry of SPCT. Mechanism of chip formation, Orthogonal and Oblique cutting, Use of chip breaker in machining, Merchant Circle (Analytical treatment expected), thermal aspects of machining, cutting temperature measurement during machining, Cutting Fluids, Machinability, Estimation of Tool life, Tool materials. **(Contemporary Issues related to Topic)**		
Unit:2	**Lathe**	**7 Hours**
Kinematic systems and operations of lathes, attachments for various operations, machine specifications, basis for selection of cutting speed, feed and depth of cut, time estimation for turning operations such as facing, step turning, taper turning, threading, knurling. Capstan and Turret Lathe and special purpose Machines: Construction, Operation and selection of Machining Parameters, Machining Centers, Tool Heads and indexers **(Contemporary Issues related to Topic)**		
Unit:3	**Shaper**	**7 Hours**
Introduction, type, specification, description of machines, hydraulic drives in shapers, cutting parameters, attachments for shaper, work holding devices, shaper operations. **Planer:** Introduction, specifications, description, type of planner, Mechanism for planner: Driving mechanism, feeding mechanism, planner cutting tools, cutting parameters **Slotter**: Introduction, specifications, description, type of drives for slotter, types of slotting.. **(Contemporary Issues related to Topic)**		
Unit:4	**Milling**	**6 Hours**
Kinematic systems and operations of milling machines, attachments for Milling. Cutting parameters, Types of milling cutters, Tool geometry & their specifications. Indexing- simple, compound and differential. Screw threads and Gear Manufacturing Methods **(Contemporary Issues related to Topic)**		

Unit:5	Grinding	7 Hours
Grinding operations, grinding wheel, specifications & selection, cylindrical &centre less grinding operation, surface grinding, tool & cutter grinding, time estimation for grinding operations. Superfinishing process: Honing, Lapping, super finishing, polishing, buffing, metal spraying, galvanizing and electroplating. Process parameters and attainable grades of surface finish, surface roughness measurement. **(Contemporary Issues related to Topic)**		
Unit :6	**Machining Operation**	**7 Hours**
Drilling: Introduction, tools for drilling, classification of drills, twist drills, drill size and specifications, carbide tipped drills, type of drilling machines, Drilling machines operations, time estimation for drilling. **Reaming:** Introduction, description of reamers, type of reaming operations. Boring: Introduction, types of boring machine, horizontal boring machine, vertical boring machine, jig boring machine, micro boring, boring operations. **Broaching:** Introduction, type of broaches, and nomenclature of broaches, type of broaching machines **(Contemporary Issues related to Topic)**		
	Total Lecture Hours	**39 Hours**

Text books	
1	Workshop Technology - Part I,Chapman W.A.JFifth edition CBS Publishers
2	Manufacturing Technology (Metal Cutting & Machine Tools) P N Rao 2nd Edition (2009) The McGraw-Hill Companies
3	Manufacturing Science Ghosh & Malik 2nd Edition (2010) East West
4	Workshop Technology (Volume-II) Hajra Choudhary 2nd Edition (2012) The McGraw-Hill Companies
Reference Books	
1	Manufacturing Engineering & Technology S Kalpakjian & SR Schmid 1st Edition (2009) Pearson Education Canada
2	Technology of machine Tools Krar & Oswald 1st Edition (1984) Gregg Division, McGraw-Hill
3	Manufacturing Processes M Begman 1st Edition (1974) Ballinger Pub. Co
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
MOOCs Links and additional reading, learning, and video material	
1	https://nptel.ac.in/courses/112/103/112103280/
2	https://nptel.ac.in/courses/106/106/106106179/
3	https://nptel.ac.in/courses/127/105/127105007/

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I SEMESTER
22ME110: Lab : Machining Process

Course Outcomes:
Upon successful completion of the course the students will be able to 1. Evaluate among various cutting tool materials and tool geometries. 2. Examine the different processes and machine tools for cylindrical surface machining. 3. Demonstrate the various machining processes and conditions for flat surface machining using SPCT. 4. Examine the machining processes for flat surfaces marching using MPCT..

S No	Experiments based on
1	Demonstration of single point cutting tools, their nomenclature, geometry materials and applications. CO I
2	Demonstration of multi point cutting tools, their nomenclature, geometry materials and applications. CO I
3	Demonstration of working of Lathe Machine and study of its mechanism. CO II
4	Demonstration of working of Shaper Machine and study of its mechanism CO III
5	Demonstration of working of Milling machine and study of its mechanism. CO IV
6	Demonstration of working of Drilling machine and study of its mechanism. CO VI
7	Practical on lathe for turning , facing , step turning , taper turning and threading. CO II
8	Practical on Shaper with exposure to auto feed. CO III
9	Practical on milling machine for slot cutting. CO IV
10	Practical on Drilling machine for drilling. CO VI
11	Demonstration of boring operations. CO VI
12	Study of Grinding machine and super finishing processes. CO V
13	Introduction to NC and CNC machines. CO II

I SEMESTER

Audit Course

GE2132: Environmental Science

Course Outcome :
Upon successful completion of the course the students will be able
1. To understand the basic concepts and problems and follow sustainable development practices
2. To enhance knowledge skills and attitude towards environment
3. To understand natural environment and its relationship with human activities.
4. To evaluate local, regional and global environmental topics related to resource use and management.

Unit I: : Introduction	**(2Hrs.)**
Definition, scope and importance; Need for public awareness – institutions in environment, people in environment.	
Unit II: : Natural Resources	**(2 Hrs.)**
Renewable and non-renewable and associated problems; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.	
Unit III: Ecosystems	**(4 Hrs.)**
Concept of an ecosystem – understanding ecosystems, ecosystem degradation, resource utilization. Structure and functions of an ecosystem – producers, consumers and decomposers. Energy flow in the ecosystem – water, carbon, oxygen, nitrogen and energy cycles, integration of cycles in nature. Ecological succession; Food chains, food webs and ecological pyramids; Ecosystem types – characteristic features, structure and functions of forest, grassland, desert and aquatic ecosystems.	
Unit IV: Bio-diversity	**(4 Hrs.)**
Introduction – biodiversity at genetic, species and ecosystem levels Bio-geographic classification of India. Value of biodiversity – Consumptive use value, productive use value, social, ethical, moral, aesthetic and optional vlue of biodiversity. India as a mega-diversity nation; hotspots of biodiversity.Threats to bio-diversity – habitat loss, poaching of wildlife, man-wild life conflicts. Common endangered and endemic plant and animal species of India. Insitu and Exsitu conservation of biodiversity. Role of individual and institutions in prevention of pollution.Disaster management – Floods, earthquake, cyclone, landslides.	
Unit V: Pollution	**(4 Hrs.)**
Definition; Causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions and nuclear hazards. Solid waste management – Causes, effects and control measures of urban and industrial waste.	

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Unit VI: Social Issues and the Environment	**(4 Hrs.)**
Unsustainable to sustainable development; Urban problems related to energy; Water conservation, rainwater harvesting, watershed management; Problems and concerns of resettlement and rehabilitation of affected people. Environmental ethics – issues and possible solutions – Resource consumption patterns and need for equitable utilization; Equity disparity in Western and Eastern countries; Urban and rural equity issues; need for gender equity. Preserving resources for future generations. Te rights of animals; Ethical basis of environment education and awareness; Conservation ethics and traditional value systems of India. Climate change, global warming, acid rain, Ozone layer depletion, nuclear accidents and holocasts. Wasteland Reclamation; Consumerism and Waste products. Environment legislations – The Environment (Protection) Act; The water (Prevention and Control of Pollution) Act; The Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislations – environment impact assessment (EIA), Citizens actions and action groups. Public awareness – Using an environmental calendar of activities, self-initiation.	
Unit VII : Human Population and the Environment	**(4Hrs.)**
Global population growth, variation among nations. Population explosion; Family Welfare Programmes – methods of sterilization; Urbanization. Environment and human health – Climate and health, infectious diseases, water-related diseases, risk due to chemicals in food, Cancer and environment. Human rights – equity, Nutrition and health rights, Intellectual property rights (IPRS), Community Biodiverstity registers (CBRs). Value education – environmental values, valuing nature, valuing cultures, social justice, human heritage, equitable use of resources, common property resources, ecological degradation. HIV / AIDS; Women and Child Welfare; Information technology in environment and human health.	
Total Lecture	**24 Hours**

Textbooks:	
1.	Perspectives in environmental studies by A. Kaushik and C. P. Kaushik.
2.	Textbook for Environmental studies by Erach Bharucha for UGC
3.	Textbook of Environmental studies by Shanta Satyanarayan, Dr. Suresh Zade, Dr. Shashikant Sitre & Dr. Pravin Meshram.
4.	Fundamental concepts in Environmental studies by Dr. D.D. Mishra. S. Chand publications

Reference Books:	
1.	Essentials of Ecology and Environmental Science by Dr. S .V .S. Rana,PHI Learning Pvt. Ltd, Delhi
2.	Environmental Chemistry by Anil Kumar De, Wiley Eastern Limited
3.	Environmental Science by T.G. Miller, Wadsworth Publishing Co, 13th edition.
4.	Ecology and Environment by P. D. Sharma, Rastogi publications

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I SEMESTER
Audit Course
MLC2121: YCAP1 -Get Set Go

Objective	Outcomes
Get Set Go program is designed to introduce students to the real world. It gives them the skills they need to reach their goals and live up to their full potential at college, home and work. The program was developed with feedback from students; it consists of interactive sessions that include real-life scenarios and role-playing. It can help young adults become more confident and better able to cope with the pressure and stress they face.	The students gain more confidence and skills required to deal with the challenges they will face in college and at home. Their interpersonal and intrapersonal skills are enhanced pushing them to think towards their future and aim for their goals.

Syllabus Subject: Communication Skills – 1st Year, No. of hours - 18

Unit No.	Topic	Duration
1	Topic: Build a foundation for success - Explain the Importance of Process of improvement, stating your Name with Impact, Recall and Use Names, Name Remembering Formula o LIRA o PACE – Individual Activity o BRAMMS o Chaining Method, Introduce "My Vision	2.5 Hours
2	Topic: Communication Fundamentals for Building Trust- Be a good listener, use conversation links, show genuine interest Hi-Five of Success □ Build on Memory Skills and Enhance Relationships □ PEG words □ Explain Permanent PEG Memory System, energize our Communications – Explain 3Vs of communication – Visual-Vocal-Verbal	3.5 Hours
	Practice Conversations, Activity – Pause-Part-Punch, Group Activity	

Unit No.	Topic	Duration
3	Topic: Increase Self Confidence - Use our experiences to communicate more confidently Communicate with clarity and conciseness Discover how past experiences influence behavior	2.5 Hours
4	Topic: Motivate Others and Enhance Relationships- Learning Objectives Explain Gain Willing Cooperation Principles Group Presentation Explain Demonstration of Leadership Principles Explain "Evidence" critical in establishing credibility	4 Hours
	Individual Activity – Sharing of defining moment, Skit to demonstrate Leadership Principles, Stranded on Island	

Unit No.	Topic	Duration
5	Topic: Fundamentals of Communication (Earn the right – Excite -Eagerness) □ Elevator Pitch □ Develop more Flexibility, □ Recap and Summarize	3.5 Hours
6	Activities - – Individual Presentation, Flexibility Drills, Individual Presentations – My Vision Assignment	2 Hours

Reference Books:

1. How to win friends & influence people – Dale Carnegie

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

2nd Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SoE No. 22ME-101

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
FIRST SEMESTER															
1	1	BS	GE/MTH	22ME101	Differential Equation, matrices and Statistics	T	3	1	0	4	4	30	20	50	3 Hrs
2	1	BS	GE/PHY	22ME102	Engineering Physics	T	3	0	0	3	3	30	20	50	3 Hrs
3	1	BS	GE/PHY	22ME103	Lab: Engineering Physics	P	0	0	2	2	1		60	40	
4	1	HS	GE/HUM	22ME104	Social Science	T	3	0	0	3	3	30	20	50	3 Hrs
5	1	BES	ME/ME	22ME105	Engineering Graphics	T	1	0	0	1	1	30	20	50	3 Hrs
6	1	BES	ME/ME	22ME106	Lab: Engineering Graphics	P	0	0	4	4	2		60	40	
7	1	BES	CT/CT	22ME107	Elements of AIML	T	3	0	0	3	3	30	20	50	3 Hrs
8	1	BES	ME/ME	22ME108	FAB Shop	P	0	0	2	2	1		60	40	
9	1	BES	ME/ME	22ME109	Machining Process	T	3	0	0	3	3	30	20	50	3 Hrs
10	1	BES	ME/ME	22ME110	Lab: Machining Process	P	0	0	2	2	1		60	40	
						TOTAL	**16**	**1**	**10**	**27**	**22**				
List of Mandetory Learning Course (MLC)															
1	1	HS	GE/T&P	MLC2121	YCAP1-Get Set Go	**A**	2	0	0	2	0				
2	1	BES	GE/CHE	GE2132	Environmental Science	**A**	2	0	0	2	0				
SECOND SEMESTER															
1	2	BS	GE/MTH	22ME201	Calculus and Vector	T	3	1	0	4	4	30	20	50	3 Hrs
2	2	BS	GE/CHE	22ME202	Engineering Chemistry	T	3	0	0	3	3	30	20	50	3 Hrs
3	2	BS	GE/CHE	22ME203	Lab: Engineering Chemistry	P	0	0	2	2	1		60	40	
4	2	HS	GE/HUM	22ME204	Professional Communication	T	3	0	0	3	3	30	20	50	3 Hrs
5	2	BES	CV/CV	22ME205	Engineering Mechanics	T	3	0	0	3	3	30	20	50	3 Hrs
6	2	BES	CV/CV	22ME206	Lab: Engineering Mechanics	P	0	0	2	2	1		60	40	
7	2	BES	EE/EE	22ME207	Basic Electrical and Electronics Engineering	T	3	0	0	3	3	30	20	50	3 Hrs
8	2	BES	IT/IT	22ME208	Programming for Problem Solving	T	3	0	0	3	3	30	20	50	3 Hrs
9	2	BES	IT/IT	22ME209	**Lab:** Programming for Problem Solving	P	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**25**	**22**				
List of Mandetory Learning Course (MLC)															
1	2	HS	GE/HUM	GE2131	Universal Human Value	**A**	2	0	0	2	0				
2	2	HS	GE/T&P	MLC2122	YCAP2 -Functional English	**A**	2	0	0	2	0				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : TA1-5 marks on Proctored Online Exam, TA2-12 marks on activitied decided by course teacher, TA3 - 3 marks on class attendance

TA = for Practical : MSPA will be 15 marks each**

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Applicable for AY 2022-23 Onwards

II SEMESTER
22ME201 : Calculus & Vector

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Apply the knowledge of differentiation to solve the Engineering problems. 2. Determine the derivatives of functions of several variables and develop the relations among the derivatives of variables. 3. Apply the knowledge of Beta and Gamma functions to find area, volume and mass. 4. Discuss Calculus of Scalar and vector point function and use appropriate theorems to evaluate integrals of functions of single and multiple variables.

Unit I: Differential Calculus I	**(6 Hrs.)**
Successive differentiation, n^{th} derivative of rational function, Trigonometrical transformations, n^{th} derivative of the product of two functions (Leibnitz's theorem), Taylor's theorem, Use of Maclaurin's theorem for one variable, standard expansions, Examples on Taylor's Theorem. **(Contemporary Issues related to Topic)**	
Unit II: Differential Calculus II	**(6 Hrs.)**
Definitions of Curvature, Radius of curvature for cartesian curves, Centre of curvature, Circle of curvature, Procedure for tracing the cartesian curve, Important points (singular points, Multiple points, Double points, Node, Cusp), Problems on tracing of curve. **(Contemporary Issues related to Topic)**	
Unit III: Partial Differentiation	**(7 Hrs.)**
Functions of several variables, First and higher order derivatives, Homogeneous functions, Euler's theorem on homogeneous function, Chain rule and total differential coefficient of composite functions. **(Contemporary Issues related to Topic)**	
Unit IV: Integral Calculus	**(6 Hrs.)**
Gamma function, Reduction formula, Beta function, Properties of Beta function (without proof), Relation between Beta and Gamma functions, Double and triple integrals and its applications. **(Contemporary Issues related to Topic)**	
Unit V: Vector Calculus	**(7 Hrs.)**
Vector differentiation, Gradient, Divergence and Curl, Directional derivatives with physical interpretation, Solenoidal and irrotational motions, vector fields. **(Contemporary Issues related to Topic)**	
Unit VI: Vector Integration & Applications	**(7 Hrs.)**
Vector integration: Line, surface and volume integrals, Statement of Stoke's theorem, Gauss divergence theorem and Green's theorem (without proof), Simple applications of these theorems. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

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Textbooks:	
1.	Erwin Kreyzig, Advance Engineering Mathematics, 6th Edition, John Wiley and Sons, INC.
2.	H.K. Dass, Engineering Mathematics, 11th revised edition, S. Chand, Delhi.
3.	H.K. Dass, Advanced Engineering Mathematics, 8th revised edition, S. Chand, Delhi.
4.	Dr. B.S. Grewal, Higher Engineering Mathematics, 42th edition, Khanna Publishers.
5.	P.N.Wartikar and J.N.Wartikar, Applied Mathematics, 4th Edition, Vidyarthi GrihaPrakashan.

Reference Books:	
1.	G B Thomas and R L Finney, Calculus and Analytical Geometry, 9th edition, Addison-Wesley, 1999.
2.	Michael Spivak and Tom Apostol, Calculus, VolI & Vol II 2nd edition, Wiley.
3.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, 10th edition, Laxmi Prakashan.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Mathematics%20and%20Humanities/

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/111/106/111106146/
2.	https://nitkkr.ac.in/docs/5-Multiple%20Integrals%20and%20their%20Applications.pdf

II SEMESTER
22ME202 : Engineering Chemistry

Course Outcomes :
Upon successful completion of the course the students will be able to
1. Illustrate qualitative and quantitative aspects of water for industrial and domestic applications. (L2)
2. Identify corrosion and discuss its prevention. (L2)
3. Establish insight into engineering materials. (L3)

Unit I : Water Conditioning	**(7 Hrs.)**
Introduction, Hardness, Types of hardness, softening of water by lime-soda process, Zeolite process, Ion Exchange Process (principle, advantages, and limitations). Numerical based on lime-soda and Zeolite process. Boiler trouble (Scale and sludge), sequestration (carbonate, phosphate) Sterilization of drinking water by chlorination. Langelier Index. **(Contemporary Issues related to Topic)**	
Unit II: Cement	**(6 Hrs.)**
Introduction, Portland cement: Manufacture, role of microscopic constituents. Properties-setting and hardening, heat of hydration and soundness. Types of cement-Rapid hardening cement, low heat cement, High alumina cement; cement additives, Ready-mix concrete, Grading of cement. **(Contemporary Issues related to Topic)**	
Unit III: Corrosion	**(7 Hrs.)**
Introduction to corrosion, electrochemical and galvanic series, Types of corrosion: Chemical and electrochemical corrosion. Mechanisms of electrochemical corrosion, Factors influencing corrosion. Differential aeration theory of corrosion, Forms of corrosion: Pitting corrosion, Intergranular corrosion, Stress corrosion, Waterline. Corrosion prevention: Design and material selection, Cathodic and anodic protection. **(Contemporary Issues related to Topic)**	
Unit IV: Lubricants	**(6 Hrs.)**
Lubricants: Introduction, Classification of lubricants, Mechanism of lubrication. Liquid lubricants: Properties & significance of liquid lubricants–Viscosity and viscosity index., Flash and fire point, Cloud and pour point, Aniline point, acid value, saponification number,. Solid lubricant-Graphite. Greases as Semisolid lubricants - Definition and Significance of Consistency test and drop point test Synthetic lubricants- silicones. Criteria for selection of lubricants: IC engines, gears, transformer. **(Contemporary Issues related to Topic)**	
Unit V: Fuels	**(7 Hrs.)**
Introduction, Calorific value, HCV, LCV, Determination of calorific value of fuels by Bomb and Boy's calorimeter. Significance of Proximate and Ultimate analysis Knocking in Internal combustion petrol and diesel engines, Octane and Cetane number, Knocking and its relationship with structure of fuels. Simple numerical on combustion calculations. **(Contemporary Issues related to Topic)**	
Unit VI: Advanced Materials	**(6 Hrs.)**
Nanomaterials: Definition of nanomaterials, nano scale. Carbon Nanotubes and types. Application of Nanomaterials: Applications of nanomaterials in medicine, environment, and electronics. Liquid Crystal Polymers: Phases of LCP's, general properties and applications. Biodegradable Polymers – Synthesis, properties and applications of polylactic acid and Polycaprolactone. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

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Textbooks:	
1.	S S. Dara , A Text book of Engineering Chemistry , S.Chand & Co New Delhi. Eleventh Edition.
2.	P.C. Jain and Monica Jain , Engineering Chemistry , Dhanpat Rai & sons New Delhi , Sixteenth Edition.
3.	P. W. Atkins, Physical Chemistry ,Oxford Publications,Eighth edition .

Reference Books:	
1.	Eskel Nordell , Water treatment for industrial and other use ,Rein hold Publishing Corporation, New York.
2.	Lloyd A.Munro ,Chemistry in Engineering ,Prentice-hall, Inc Nj,2nd Edition.
3.	Robert B Leighou Mc Graw ,Chemistry of Engineering Materials ,Hill Book Company, Inc New York.
4.	B.K.Sharma Krishna , Engineering Chemistry ,Prakashan media private LTD. 1st Edition, 2014.
5.	R.V.Gadag, A.Nityananda Shetty ,Engineering Chemistry ,I K International Publishing House New Delhi , First Edition.
6	Fred. Billmeyer Jr. ,A textbook of polymer science, Wiley India ,Third Edition.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/CHEMISTRY/

MOOCs Links and additional reading, learning, video material	
1.	**https://www.youtube.com/watch?v=dCimAH5IRSA**
2.	https://www.youtube.com/watch?v=5OxdXq91TV0
3.	https://www.youtube.com/watch?v=aoWBUhlN3-0
4.	https://www.youtube.com/watch?v=4J3NhT5WRzY
5.	https://www.youtube.com/watch?v=cx5gPKp9QEc

II SEMESTER
22ME203 : Lab: Engineering Chemistry

Course Outcomes
Upon successful completion of the course the students will be able to
1. Illustrate qualitative and quantitative aspects of water for industrial and domestic applications. (L2) 2. Identify corrosion and discuss its prevention. (L2) 3. Establish insight into engineering materials. (L3)

Total 10 experiments are to be performed
(4 each from Phase I and Phase II and two demonstration experiments)

SN	Experiments based on
	List of Experiments-Phase I
1	Determination of total hardness of water sample.
2	Determination of alkalinity present in the water sample.
3	Estimation of Fe2+ ions by redox titration
4	Determination of copper by iodometric titration
5	Estimation of Nickel.
6	To determine the strength of a given potassium dichromate solution with N/20 sodium thiosulphate solution
7	Determination of COD of water sample.
8	Synthesis of polyaniline.
9	Determination of rate of the reaction of hydrolysis of ethyl acetate at room temperature and analysis of experimental data using Computational Software.
	List of Experiments-Phase II
1	Determination of viscosity of lubricating oil by Redwood Viscometer I or II
2	Determination of Cation exchange capacity of an ion exchange resin
3	Determination of molecular weight of a polymer.
4	Oil Testing for Flash Point / Cloud Point/Pour Point/Aniline Point
5	Proximate analysis of coal
6	Determination of surface tension of liquids using stalagmometer.
7	Determination of electrochemical equivalence of Copper using Faradays Law
8	To determine the heat of solution of potassium nitrate calorimetrically.
9	Determination of conductivity of water sample by conductivity meter.
10.	To verify Beer-Lambert law for KMnO4 and determine the concentration of the given solution of KMnO4

	List of Demonstration Experiments
1	Determination of pH of water sample by pH meter
2	Synthesis of urea formaldehyde resin.
3	Determination of consistency of grease sample by using penetrometer.
4	Determination of Drop Point of grease sample.

II SEMESTER
22ME204 : Professional Communication

Course Outcomes :

Upon successful completion of the course the students will be able to

1. Apply different modes for effective communication.
2. Use competently phonology of English language.
3. Apply nuances of LSRW skills.
4. Communicate through different channels.

Unit I: Basics of Communication	**(7 Hrs.)**
Language as a tool of communication & characteristics of language Process of Communication, Levels of Communication, Flow of Communication, Networks of Communication, Classification of Barriers (Intrapersonal, Interpersonal, Organizational). **(Contemporary Issues related to Topic)**	
Unit II: English Phonetics	**(6 Hrs.)**
Speech Mechanism, Organs of speech, Consonant and Vowels sounds, Word stress rules. **(Contemporary Issues related to Topic)**	
Unit III: Presentation & Visual Communication	**(7 Hrs.)**
Presentation and audience analysis, Organizing content, Nuances of presentation, Visual Communication – Introduction & importance, Role & Psychology of color in visual communication. **(Contemporary Issues related to Topic)**	
Unit IV: Verbal Skills	**(7 Hrs.)**
Listening Skills -definition types and traits. Group Communication- (Purpose, Different types of Group Communication, Organizational GD, GD as a part of selection process), Meeting (purposes, preparation, procedure and minutes of meeting). **(Contemporary Issues related to Topic)**	
Unit V: Interview Skills	**(6 Hrs.)**
Purpose, expectations of employer and preparation for Interview, Types, Types of Questions & Answering Techniques, Telephonic Interviews – preparation and guidelines, Reading Techniques (Exercise based on Complex Unseen passages. **(Contemporary Issues related to Topic)**	
Unit VI: Technical Written Communication	**(6 Hrs.)**
Memo, Email, Report -Types, Characteristics, prewriting aspects of report and preparing writing aspects of report), Types of paragraphs. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

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Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Raman & Sharma, Technical Communication, Oxford University Press.
2.	T. Balasubramaniam, Textbook of English Phonetics for Indian Students, Macmillan India Ltd.

Reference Books:	
1.	Public Speaking, Dale Carnegie, How to Develop Self – Confidence & Influence People.
2.	Asha Kaul, Communication Skills.
3.	Allen Peas, Body Language.
4.	Gerson's Gerson, Technical Communication.

MOOCs Links and additional reading, learning, video material	
1.	https://dl.uswr.ac.ir/bitstream/Hannan/141245/1/9781138219120.pdf
2.	https://www.pdfdrive.com/word-power-made-easy-the-complete-handbook-for-building-a-superior-vocabulary-e157841139.html
3	https://www.pdfdrive.com/improve-your-communication-skills-present-with-confidence-write-with-style-learn-skills-of-persuasion-e156963640.html
4	https://www.pdfdrive.com/21-days-of-effective-communication-everyday-habits-and-exercises-to-improve-your-communication-skills-and-social-intelligence-e158273760.html

II SEMESTER

22ME205 : Engineering Mechanics

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Describe the fundamental concepts of statics and dynamics. 2. Apply the basic concepts of applied mechanics for solution of problems on planar force system. 3. Determine the properties of surface like centroid, moment of inertia, etc. for planar surfaces and mass moment of inertia for rigid body. 4. Analyze pin jointed truss frame structure and beam structure analytically and graphically. 5. Evaluate the dynamic variables of kinetics of particles and simple lifting machine

Unit I: Resultant of planar force System	**(7 Hrs.)**
Fundamental concepts, system of forces, laws of mechanics, principle of transmissibility of force, Moment of force, Principle of moment, Couple, Resultant of a planar force system, Equivalent force couple system. **(Contemporary Issues related to Topic)**	
Unit II: Equilibrium of planar force System	**(6 Hrs.)**
Free body diagrams, Conditions of equilibrium, types of supports, types of beams, types of loads on beam, Equilibrium of a planar force system. **(Contemporary Issues related to Topic)**	
Unit III: Friction and Trusses	**(7 Hrs.)**
Friction: Coulomb's laws of dry friction, plane friction, belt friction. Trusses: Types of trusses, assumptions in analysis of truss, Analysis of truss by method of joint. **(Contemporary Issues related to Topic)**	
Unit IV: Properties of Surfaces	**(6 Hrs.)**
Centroid: Introduction, First Moment of Area, Centroid of composite areas. Moment of Inertia: Introduction, Second Moment of Area, Polar moment of Inertia, Radius of Gyration, Transfer formula for moment of Inertia, Product of Inertia, Moment of Inertia, and product of inertia for composite areas, Principal Moments of Inertia. **(Contemporary Issues related to Topic)**	
Unit V: Virtual Work Method and Kinetics of Particle	**(7 Hrs.)**
Virtual Work Method: Introduction, Principle of virtual work, Application to beam and frame. Kinetics of Particle: Introduction, Newton's law of motion for a Particle, D' Alembert's principle, Translation of particle and connected system. **(Contemporary Issues related to Topic)**	
Unit VI: Work Energy and Impulse Momentum Method	**(6 Hrs.)**
Work Energy Method: Introduction, Work energy equation for translation, Work energy applied to particle motion and connected system. Impulse Momentum Method: Introduction, Linear Impulse momentum, Conservation of linear momentum, coefficient of restitution, elastic impact, Impulse momentum in plane motion. **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Nelson A., Engineering Mechanics (Statics and Dynamics), ed 2009, Tata Mc. Grew Hill Education Pvt. Ltd., New Delhi, 2009.
2.	Dubey N.H., Engineering Mechanics (Statics and Dynamics) first edition 2013, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi, 2013.
3.	Singer F.L, Engineering Mechanics (Statics and Dynamics), Harper and Rowe publication, New Delhi, 1994.
Reference Books:	
1.	Timoshenko S, Young D.H and Rao J.V, Engineering Mechanics, Mc. Graw Hill Publication, New Delhi, 2007.
2.	Bhattacharyya B., Engineering Mechanics, Oxford University Press, New Delhi, 2008.
3.	Hibbeler R.C, Engineering Mechanics (Statics and Dynamics), Pearson Publication, Singapore, 2000.
4.	Shames I.H. and Rao J.V., Engineering Mechanics (Statics and Dynamics), First Edition, Pearson Publication, New Delhi, 2003.
5.	Beer F.P. and Johnston E.R; Vector Mechanics for Engineers, 9th edition Tata Mc. Graw Hill Publication, New Delhi. 2007.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf
MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=nGfVTNfNwnk
2.	https://www.youtube.com/watch?v=6nguX-cEsvw
3.	https://nptel.ac.in/courses/112103108

II SEMESTER

22ME206 : Lab : Engineering Mechanics

Course Outcomes
Upon successful completion of the course the students will be able to 1. Describe the fundamental concepts of statics and dynamics. 2. Apply the basic concepts of applied mechanics for solution of problems on planar force system. 3. Determine the properties of surface like centroid, moment of inertia, etc. for planar surfaces and mass moment of inertia for rigid body. 4. Analyze pin jointed truss frame structure and beam structure analytically and graphically. 5. Evaluate the dynamic variables of kinetics of particles and simple lifting machine

Minimum Eight Practical's to be performed from the list as below

SN	Experiments based on
1	To find determine the support reactions of a Simply Supported Beam experimentally and analytically.
2	To determine the forces in the members of a Jib Crane Apparatus experimentally and graphically.
3	To determine the coefficient of friction between two surfaces of different material on Plane Friction Apparatus.
4	To determine the coefficient of friction of Coil Friction Apparatus.
5	To determine the forces in members of a Shear Leg Apparatus experimentally and manually.
6	To determine the mass moment of inertia of a fly wheel using Fly Wheel Apparatus
7	To determine efficiency and law of machine of Differential Axel & Wheel machine.
8	To determine efficiency and Law of machine of Single Purchase Crab machine.
9	To determine efficiency and Law of machine of Double Purchase Crab machine.
10	To verify law of polygonal of forces using Law of Polygon Apparatus.
11	To find support reactions of a simply supported beam using graphical method and hand calculation.
12.	To find the forces in the member of truss using graphical method and hand calculation.
13.	To find (1) Principle moment of inertia and (2) Moment of inertia and product of inertia about any inclined axis for a composite figure using Mohr's circle and hand calculation,

II SEMESTER
22ME207 : Basic Electrical and Electronics Engineering

Course Outcomes :
Upon successful completion of the course the students will be able to
1. Understand the fundamental concepts of Analog Electronic and Electrical Circuits
2. Apply the concepts of Electrical and Electronic Circuits to obtain the desired parameter
3. Analyse analog Electrical Circuits for given application.
4.Analyze analog Electronic Circuits for given application.

Unit I: CIRCUIT ELEMENTS AND ENERGY SOURCES	**(7 Hrs.)**
Circuit Elements, Series and Parallel Combination of Resistances, Inductance and Capacitances, Energy Sources, Source Transformation, Sources with Periodic Waveforms, A.C. in Inductance and Capacitance, Star-Delta Connection. **(Contemporary Issues related to Topic)**	
Unit II: ANALYSIS OF NETWORK	**(7 Hrs.)**
Kirchhof's Laws, Current Division, Voltage Division, Nodal and Mesh Analysis of Electric Circuits, Superposition Theorem, Thevenin's Theorem. **(Contemporary Issues related to Topic)**	
Unit III: TRANSFORMER AND MOTORS	**(7 Hrs.)**
Introduction to Transformer, Construction, Working principle, Types of transformers, Introduction to DC Motor, Working Principle of DC Motor, Types of Motors. **(Contemporary Issues related to Topic)**	
Unit IV: DIODE AND TRANSISTOR	**(7 Hrs.)**
Introduction to Semiconductor, P-N junction diodes, Biasing & Characteristics of diodes. Diode Circuits - Half wave rectifier, full wave rectifier, bridge rectifier. Introduction to BJT- NPN and PNP, Modes of operation, Configuration and its Characteristics. **(Contemporary Issues related to Topic)**	
Unit V: OPERATIONAL AMPLIFIER AND ITS APPLICATION	**(7 Hrs.)**
Introduction to Op-Amp, Inverting and Non-Inverting Amplifier, Linear Applications of OP-AMP like adder, Subtractor, integrator, differentiator and non-linear application using Comparator.	
Unit VI: Electronics Measurement	**(7 Hrs.)**
Introduction to Measurement System, Generalized block diagram of Measurement System, Static & dynamic characteristics of measurement system, Types of errors & their sources, Statistical analysis. **(Contemporary Issues related to Topic)**	
Total Lecture	**42 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford Higher Education, First Edition 2005
2.	Electronics Devices and circuits, Millman Jacob, McGraw Hill Education, Fourth Edition (2015)
3.	Circuit Theory (Analysis and Synthesis) , by A. Chakrabarti, Dhanpat Rai & Co., Reprint Edition 2014

Reference Books:	
1.	OP-AMP and Linear Integrated Circuit, by Ramakant A. Gayakwad, Prentice Hall India Learnin Private Limited, Published in 2002
2.	Electrical & Electronic measurement & Instrument, A. K. Sawhney, Dhanpat Rai & Co.,18th edition 2008

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc22_ee113/preview

II SEMESTER

22ME208 : Programming for Problem Solving

Course Outcomes :
On completion of this course, the student will be able to
1) Describe the basics of computer system components and operation, basics of algorithms and flowcharts (L2)
2) Develop programs using conditional statements and loops user defined functions, and pointers.(L3)
3) Analyze single and multi-dimensional arrays as a data structure and its use in problem solving.(L4)
4) Describe the basics of Strings, Structures, Unions, and File handling and its use for problem solving.(L2)

Unit I: Computer System Basics:	**(6 Hrs.)**
Introduction to components of a computer system (disks, memory, processor), how program is executed, understanding of concepts such as operating system, compilers, source and object programs, etc. Introduction to algorithms and flowcharts. **Basic building blocks of C:** Character set, variables, identifiers & keywords, Data types, Operators: arithmetic, logical and relational operators, precedence of operators **(Contemporary Issues related to Topic)**	
Unit II: Basics of C Programming	**(6 Hrs.)**
Expressions, sizeof() operator, constants, typedef statement, basic input/output statements and functions (scanf, printf, getch, putch, gets, puts), Introduction to library functions, writing straight line programs.Decision control statements: if, if - else and nested if-else statements, else-if ladder statement, switch-case control statement. **(Contemporary Issues related to Topic)**	
Unit III: Loop Structures:	**(6 Hrs.)**
While, do while and for loops, break and continue statement, "goto" statement, real life programming examples based on these loop structures, bitwise operators, real life programming examples. **(Contemporary Issues related to Topic)**	
Unit IV: Modular programming:	**(7 Hrs.)**
Concept of functions, user defined functions, function prototypes, formal parameters, actual parameters, return types, call by value , C programs using functions, Recursive functions, comparing recursion against iteration, C programs using recursive functions, Concepts of a pointer, call by reference, types of programming errors, real life programming examples **(Contemporary Issues related to Topic)**	
Unit V: Arrays:	**(7 Hrs.)**
One dimensional array, array manipulation, insertion, deletion of an element, searching techniques- Linear and binary search, sorting techniques – Bubble sort , and selection sort. Two-dimensional arrays: matrix representation, programs for basic matrix operations such as addition, multiplication and transpose, Array as function arguments. Strings: string representation and string handling functions, real life programming examples **(Contemporary Issues related to Topic)**	
Unit VI: Structure and Union, Concepts of files:	**(7 Hrs.)**
Introduction to structure and union, types of files, file opening in various modes, file opening and closing, fseek(), reading and writing text files, concept of pre-processor directives and macros, command line arguments, real life programming examples **(Contemporary Issues related to Topic)**	
Total Lecture	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Mastering C, K.R.Venugopal& S.R. Prasad, TMH,2007.
2.	Programming in ANSI C, E. Balaguruswamy, Mc Graw Hill Education
3.	The C Programming Language., J.B.W.Kernighan&D.M.Ritchie, Prentice Hall

Reference Books:	
1.	Problem Solving And Program Design In C, Jeri. R. Hanly, Elliot B. Koffman, Pearson Education
2.	Programming with C, Byron Gottfried, Schaum;s Outline Series
3.	How to solve it by computers, R. G. Dromey, Prentice Hall India

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/e-copies%20of%20books/7.Information%20Technology/27.c.pdf
2	http://103.152.199.179/YCCE/DTEL%20Material/7.Information%20Technology/DTEL%20PPTs/11.ITCP_E_SSG.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/106/104/106104128/

II SEMESTER
22ME209 : Lab : Programming for Problem Solving

Course Outcomes
Upon successful completion of the course the students will be able to
1) Describe the basics of computer system components and operation, basics of algorithms and flowcharts (L2)
2) Develop programs using conditional statements and loops user defined functions, and pointers.(L3)
3) Analyze single and multi-dimensional arrays as a data structure and its use in problem solving.(L4)
4) Describe the basics of Strings, Structures, Unions, and File handling and its use for problem solving.(L2)

SN	Experiments based on
1(A)	Introduction to Linux Operating system & it's different commands.
1(B)	Introduction to Vi editor, Compilation and Execution of a program in Linux.
2	Practical based on Arithmetic and Conditional operators.
3(A)	Practical based on Decision Control statements
3(B)	Practical based on Case Control statements (switch)
4	Practical based on Looping Statements. (for/while/do-while)
5	Practical based on Functions and Recursion.
6(A)	Practical based on 1-D Array. (Searching)
6(B)	Practical based on 1-D Array. (Sorting)
7	Practical based on 2-D Array.
8	Practical based on Strings
9	Practical based on Structures.
10	Practical based on Files.

II SEMESTER
Audit Course
GE2131: Universal Human Value

Course Outcomes
Upon successful completion of the course the students will be able to 1.Experiential validation through the way to verify right or wrong. 2. Practice living in harmony with natural acceptance. 3. Realize the importance of relationships**.** 4. Recognize the importance of sustainable co-existence in existence.

Unit I: Course Introduction Need, Basic Guidelines, Content and Process for Value Education	**(4 Hrs.)**
Understanding the need, basic guidelines, content and process for Value Education Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations	
Unit II: Understanding Harmony in the Human Being - Harmony in Myself!	**(4 Hrs.)**
Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I'	
Unit III: Understanding Harmony in the Family	**(4 Hrs.)**
Understanding Harmony in the family – the basic unit of human interaction Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship Understanding the meaning of Vishwas; Difference between intention and competence Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship	
Unit IV: Understanding Harmony in the Society-	**(4 Hrs.)**
Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and ,differentiation; the other salient values in relationship ,Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sahasttva as comprehensive Human Goals,Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhauma Vyavastha)- from family to world family! ,Practice Exercises and Case Studies will be taken up in Practice Sessions	

Unit V: Understanding Harmony in the Nature -	**(4Hrs)**
Whole existence as Co-existence, Understanding the harmony in the Nature Interconnectedness and mut Practice Exercises and Case Studies will be taken up in the Practice Sessions.ual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Practice Exercises and Case Studies will be taken up in the Practice Sessions.	
Unit VI :Understanding Harmony in the Existence -	**(4Hrs)**
Understanding Existence as Coexistence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence ,Practice Exercises and Case Studies will be taken up in the Practice Sessions.	
Total Lecture	**24 Hours**

Textbooks:	
1.	**The primary resource material for teaching this course consists of text book** A foundation course in Human Values and professional Ethics, Excel books, 1st Edition 2011, R.R Gaur, R Sangal, G P Bagaria

Reference Books:	
1.	**The teacher's manual** A foundation course in Human Values and professional Ethics, Excel books,1st Edition 2011, R.R Gaur, R Sangal, G P Bagaria

II SEMESTER
Audit Course
MLC2122: YCAP2 -Functional English

MLC2122 YCAP-II	**No of Evaluations**	**Result of successful completion of YCAP II shall be calculated based on the basis of evaluations.** **To pass the exam a students must score 50% marks**
Evaluation Scheme	EVAL-I	
	100 marks	

Objective	Objective
The aim of this course is to get the students to a common level in spoken English. The majority of the target group is expected to know English as a foreign/official language. Thus the objective of the course is to make the students comfortable in using it as a spoken language when the situation demands	Students will heighten their awareness of correct usage of English grammar in writing and speaking.

Syllabus Subject: Functional English – 2nd Sem , No. of hours - 20

Unit No.	Topic	Duration
1	Introduction to Functional English - What is FE? And Areas of application. Basic Interactive sentences - Greetings & Replies, Asking for information, Telling people what you do, Asking somebody's opinion, Giving your opinion, Saying someone is correct, Saying that someone is wrong, Apologizing, Praising someone's work, Saying goodbye	2 hours
2	Introduction & Basics of Common Expressions – Offer, Request, Gratitude, Apology Modal Verbs - Words used often : Can- could, Will – would, Shall – should, Ought to-Must, May-might	2 hours
	Practice exercises, Practice Conversations, Script Activity	1.5 Hours
	Quiz on the above Topics, Exercises for Evaluation	0.5 Hours

Unit No.	Topic	Duration
3	Topic: Internet & Social Media Communication Introduction & Basics to Social Networking, Texting & Instant messaging, Blogs & Discussion Board- discussion with examples, Ethics of Social media & communication	3 Hours
	Topic: Introduction to Creative Ads Why Ads, Whats in it for me?, Characteristics of ads, Assignment	
4	Topic: Tenses -1 Introduction & Basics, Simple Tense (Past, Present, Future), Continuous Tense (Past, Present, Future) – discussion with examples	4 Hours
	Assignment Presentation on Mad Ads, Quiz on Tenses and Social Media-Internet Communication	

Unit No.	Topic	Duration
5	Topic: Tenses -2 Introduction & Basics, Perfect Tense (Past, Present, Future), Perfect Continuous Tense (Past, Present, Future) – discussion with examples	3.5 Hours
	Topic: Introduction to Movie Magic Learn English with films, Film Vocabulary, Describing a film, Types of Films,	
6	Topic: Written Communciation Introduction & Basics of Writing, Five methods of communication, Mind your grammar, Commonly confusing words Letters – Format, Parts of a business letter, When does communication fail?, Things to remember, Positive language not negative language, Active voice not passive voice Effective emailing -How to make an effective e-mail, Few common e-mail habits that cause problems, Parts of an e-mail, Some other important aspects	3.5 Hours
	Assessment – Letter and Email Writing, Tenses - Quiz	

Reference Books:	
1.	Soft Skills and Professional Communication, Francis Peters SJ, Mcgraw Hill Education
2.	Bringing out the best in People, Aubrey Daniels, Mcgraw Hill

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/channel/UCLsI5-B3rIr27hmKqE8hi4w
2.	https://www.youtube.com/channel/UC1Y1I4shF84scQ4HBThahcg

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

3rd Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
THIRD SEMESTER															
1	3	BS	GE/MTH	22ME301	Integral Transforms and Partial Differential Equations	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	3	HS	GE/HUM	22ME302	Fundamentals of Management and Economics	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	3	PC	ME/ME	22ME303	Material Science & Metallurgy	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	3	PC	ME/ME	22ME304	**Lab:-** Material Science & Metallurgy	**P**	0	0	2	2	1		60	40	
5	3	PC	ME/ME	22ME305	Manufacturing Process	**T**	3	0	0	3	3	30	20	50	3 Hrs
6	3	PC	ME/ME	22ME306	**Lab:-** Manufacturing Process	**P**	0	0	2	2	1		60	40	
7	3	PC	ME/ME	22ME307	Kinematics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	3	PC	ME/ME	22ME308	Mechanics of Materials	**T**	3	1	0	3	3	30	20	50	3 Hrs
9	3	PC	ME/ME	22ME309	**Lab:-** Mechanics of Materials	**P**	0	0	2	2	1		60	40	
10	3	PC	CV/EL	22ME310	Environmental Sustainability, Pollution and Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
						TOTAL	**21**	**1**	**6**	**27**	**24**				
List of Mandatory Learning Course (MLC)															
1	3	HS	GE/T&P	MLC2123	YCAP3 -	**A**	3	0	0	3	0				
2	3	HS	ME	MLC103	Computer Aided Design	**A**	2	0	0	2	0				
FOURTH SEMESTER															
1	4	BS	ME/ME	22ME401	Production Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	4	PC	ME/ME	22ME402	Design of Machine Elements	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	4	PC	ME/ME	22ME403	Engineering Thermodynamics	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	4	PC	ME/ME	22ME404	Fluid Mechanics	**T**	3	1	0	3	4	30	20	50	3 Hrs
5	4	PC	ME/ME	22ME405	**Lab:-** Fluid Mechanics	**P**	0	0	2	2	1		60	40	
6	4	PC	ME/ME	22ME406	Dynamics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	4	PC	ME/ME	22ME407	**Lab:-** Dynamics of Machines	**P**	0	0	2	2	1		60	40	
8	4	PC	ME/ME	22ME408	Metrology & Quality control	**T**	3	0	0	3	3	30	20	50	3 Hrs
9	4	PC	ME/ME	22ME409	**Lab:-** Metrology & Quality control	**P**	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**24**	**22**				
List of Mandatory Learning Course (MLC)															
1	4	HS	GE/T&P	MLC2124	YCAP4 -	**A**	3	0	0	3	0				
2	4	HS	ME	MLC104	MATLAB for Mechanical Engineering	**A**	2	0	0	2	0				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : TA1-5 marks on Proctored Online Exam, TA2-12 marks on activitied decided by course teacher, TA3 - 3 marks on class attendance

TA = for Practical : MSPA will be 15 marks each**

		June 2022	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

III SEMESTER

22ME301 : Integral Transforms and Partial Differential Equations

Course Outcomes:
Upon successful completion of the course the students will be able to 1 Apply the knowledge of Laplace and Fourier transforms to solve the continuous problems. 2. Apply the knowledge of Z transforms to solve the discrete mathematical equations. 3. Determine Fourier series expansion of periodic functions, Fourier Transform. 4. Use appropriate methods to solve partial differential equations.

Unit:1	Laplace Transforms	6 Hours
Definition and examples of Laplace transforms, properties of Laplace transforms, Examples by using properties of Laplace transforms, Unit step function, periodic function. **Contemporary Issues related to Topic**		

Unit:2	Inverse of Laplace Transform	7 Hours
Definition and examples of Inverse Laplace transforms, Inverse Laplace transform by using properties, Partial fraction method to find Inverse Laplace transforms, convolution theorem, Applications of Laplace transform to solve ordinary differential equations. **Contemporary Issues related to Topic**		

Unit:3	Z-Transform	6 Hours
Some elementary concepts, Definition of Z-Transform, Examples of Z-Transform, Properties (without proof), Inversion by partial fraction decomposition and residue theorem, Applications of Z-transform to solve difference equations with constant co-efficient. **Contemporary Issues related to Topic**		

Unit:4	Fourier Series	7 Hours
Periodic Functions, standard results, Fourier series expansion, Convergence of Fourier Series, Fourier Series for even and odd function, Change of interval, half range Fourier Series, Examples on half range sine and cosine series. **Contemporary Issues related to Topic**		

Unit:5	Partial Differential Equation	7 Hours
Partial Differential Equations of first order and first degree i.e., Lagrange's form, Linear homogeneous equations of higher order with constant coefficient. Application of variable separable method to solve first and second order partial differential equations. . **Contemporary Issues related to Topic**		

Unit :6	Fourier Transform	6 Hours
Definition of Fourier Integral Theorem, Fourier Transforms, Fourier sine and cosine integrals, Finite Fourier sine and cosine Transforms, Convolution Theorem**,** Parseval's Identity. **Contemporary Issues related to Topic**		
	Total Lecture Hours	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Text books	
1	Erwin Kreyzig, Advance Engineering Mathematics, 9th Edition, John Wiley and Sons, INC.
2	Dr. B. S. Grewal, Higher Engineering Mathematics, 40th edition, Khanna Publisher.
3	H.K. Dass, Advanced Engineering Mathematics, 8th revised edition, S. Chand, Delhi.

Reference Books	
1	Chandrika Prasad, Mathematics for Engineers, 19th Edition, John Wiley and Sons, INC.
2	L. A. Pipes and Harville, Applied Mathematics for Engineers, 3rd Edition, McGraw Hill.
3	P.N. and J. N. Wartikar, A text book of Applied MAthematics, 3rd edition, Pune Vidyarthi Griha Prakashan
4	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, 10th edition, Laxmi Prakashan.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Applied%20Sciences%20&%20Humanities/Mathematics%20and%20Humanities/

MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/111106111
2	https://onlinecourses.nptel.ac.in/noc22_ma41/preview
3	https://archive.nptel.ac.in/courses/111/101/111101153/

III SEMESTER
22ME302 : Fundamentals of Management and Economics

Course Outcomes:
Upon successful completion of the course the students will be able to 1. Explain the Functions of Management and identify tools and techniques of Marketing of goods and services 2. Analyze the role of Financial Accountancy and Management in the Organization 3. Develop perspective about the economy based on logical reasoning and estimate the economic outcomes. 4. Interprets comparative advantage of resources.

Unit:1	Principles of Management	6 Hours
Evolution of Management Thought: Scientific and Administrative Theory of Management, Definition and Concept of Management, Functions of Management: Planning, Organizing, Directing, Coordinating and Controlling, Motivational Theories, Concept of Leadership **Contemporary Issues related to Topic**		
Unit:2	**Marketing Management**	**6 Hours**
Marketing Management - Definition & scope, Selling & Modern Concepts of Marketing, Market Research, Customer Behaviors, Product Launching, Sales Promotion, Pricing, Channels of Distribution, Advertising, Market Segmentation, Marketing Mix, Positioning, Targeting **Contemporary Issues related to Topic**		
Unit:3	**Financial Accountancy and Management**	**7 Hours**
Definition & Functions of Finance department, Sources of finance, Types of capital, Types of Taxes, Introduction of Accountancy and its rules, Preparation of Books of Account- Jounal, Posting of transaction into ledger and preparation of trial balance, Introduction of trading account, profit and loss account and balance sheet **Contemporary Issues related to Topic**		
Unit:4	**Introduction to Economics and engineering Economy:**	**6 Hours**
Economics and engineering economy, Utility analysis- Cardinal, ordinal, Law of diminishing marginal utility, Laws of demand and supply, elasticity of demand, its measurement and application. **Contemporary Issues related to Topic**		
Unit:5	**Engineering Production and Costs**	**7 Hours**
Factors of Production: Land, Labour, Capital, Enterprise and their peculiarities, Concepts and types of costs, Law of Variable proportions (Law of diminishing marginal returns) and Return to Scale (Increasing, constant and decreasing), Economies and diseconomies of scale. Inflation: Meaning, types, causes and consequences, measures to control inflation, Concepts of deflation and Stagflation. **Contemporary Issues related to Topic**		

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Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Unit :6	Market structures - equilibrium output and price	7 Hours
Forms of market structures: Perfect competition, monopolistic competition, oligopoly, duopoly and monopoly, Demand and revenue curves for firm and industry in various forms of market structure, Total, average and marginal revenue curves, equilibrium of firms and industries under various forms of market structures, Price discrimination. **Contemporary Issues related to Topic**		
Total Lecture Hours		**36 Hours**

Textbooks	
1.	Principle of Management, 9th edition , Harold Koontz Ramchandra, Tata McGrow hills
2.	Marketing Management: Planning, Implementation and Control, 3rd Edition, Ramaswamy V.S. and Namakumari S, Macmillian
3.	Financial Services, 19th Edition, Khan M Y, Tata McGraw Hill, 19
4.	Modern Economics, 13th Edition, H. L. Ahuja, S. Chand Publisher, 2009
5.	Modern Economic Theory, 3rd edition, K. K. Devett, S. Chand Publisher,2007
6.	Principle of Economics, 7th edition, Mankiw N. Gregory, Thomson, 2013

Reference Books	
1.	Foundations of Financial Markets and Institutions, 3rd Edition, Fabozzi, Pretice Hall
2.	Fundamentals of Financial Instruments , 2nd Edition, Parameshwaran, Wiley India
3.	Marketing Management , 3rd Edition , RajanSaxena, Tata McGraw Hill
4.	Advance Economic Theory, 17th Edition, H. L. Ahuja**,** S. Chand Publisher, 2009
5.	International Trade, 12th edition, M. L. Zingan, Vindra Publication, 2007
6.	Macro Economics, 11th edition, M. L. Zingan, Vindra Publication, 2007
7.	Monitory Economics:, 1st Edition, M. L. Sheth, Himayalaya Publisher, 1995
8.	Economics of Development and Planning, 12th edition, S. K. Misra and V. K. Puri, Himalaya Publishing House, 2006.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1	https://onlinecourses.nptel.ac.in/noc22_mg104/preview
2	https://nptel.ac.in/
3	https://onlinecourses.nptel.ac.in/noc20_mg31/preview
4	https://onlinecourses.nptel.ac.in/noc21_hs52/preview
5	https://onlinecourses.nptel.ac.in/noc22_hs67/preview

III SEMESTER

22ME303 : Material Science and Metallurgy

Course Outcomes :

Upon successful completion of the course the students will be able to

1. Distinguish between ferrous and Non-ferrous materials. Illustrate crystal structures for various materials and Differentiate or Distinguish between ferrous and Non-ferrous materials.
2. Interpret Iron-Iron carbide equilibrium diagram and analyse microstructure, general properties of commercial steels and Cast Iron.
3. Discuss the various heat treatment processes for steels.
4. Demonstrate the basics of powder Metallurgy for powder metallurgical components.

Unit I:	**(7 Hrs.)**

Introduction to materials, classification of materials. Properties and applications of materials.
Crystalline nature of metals, specially microscopic and macroscopic examinations of metals.
Alloys and solid solutions, types and their formations, modified Gibbs's phase rule, Lever rule for phase mixtures and their application in system.

Contemporary Issues related to Topic

Unit II:	**(6 Hrs.)**

Study of equilibrium diagrams and invariant reactions. Iron-Iron carbide equilibrium diagram, critical temperatures. Microstructure of slowly cooled steels. Estimation of carbon from microstructures; structure property relationship. Welding Metallurgy and solidification.

Contemporary Issues related to Topic

Unit III:	**(6 Hrs.)**

Classification and application of plain carbon steels. Examples of alloy steel such as Hadfield Manganese Steel, ball Bearing Steels, etc. Effect of alloying elements.
Tool Steels – Classification, composition, application and commercial heat treatment practice for HSS, Secondary hardening.
Stainless Steels - Classification, composition, application and general heat treatment practice for Stainless Steels.

Contemporary Issues related to Topic

Unit IV:	**(7 Hrs.)**

Heat treatment and its importance. Annealing, Normalizing, Hardening, Quench Cracks, Hardenability test.
TTT diagram and its construction and related Heat Treatment Processes such as Austempering, Martempering, Patenting etc. Retention of Austenite, Effects and elimination of retained austenite, Tempering.
Case / Surface hardening treatments such as Carburising, Nitriding, Cyaniding, Carbonitriding, Flame and Induction hardening.

Contemporary Issues related to Topic

Unit V:	**(7 Hrs.)**

Cast Iron – Classification, White cast Iron, Gray Cast Iron, Nodular Cast Iron, Malleable Cast Iron, Chilled and alloy Cast Iron. (Production route, Composition, Microstructure and applications) Effects of various parameters on structure and properties of Cast Iron, Alloy cast Iron such as Ni-resist, Ni-hard.
Non-Ferrous Alloys – Study of non-ferrous alloys such as brasses (Cu-Zn diagram), Bronzes (Cu-Sn diagram), Aluminum Alloys (e.g. Al-Si & Al-Cu diagram), Bearing materials.

Unit VI:	(6 Hrs.)
Powder Metallurgy: Powder manufacture and Conditioning, Production of Sintered Structural Components, Self lubricating bearing, Cemented Carbides, Ceramics, Sintered Carbide cutting tools.	
Total Lecture	**39 Hours**

Textbooks:	
1.	Dr. V.D. Kodgire, Material Science and Metallurgy, Edition, 1st Jan 2011, Everest Publication House.
2.	Dr. B K Agrawal, Introduction to Engineering Metallurgy, 21st revised edition, 2007, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi.

Reference Books:	
1.	Sidney H. Avner, Introduction to Physical Metallurgy, 29st revised edition, 2009, Mc. Graw Hill Publication, New Delhi, 1964.
2.	Yu Lakhtin, Engineering Physical Metallurgy and Heat Treatment, 21st revised edition, 1988, Mir publishers, Moscow, Russia
3.	E C Rollason, Metallurgy for Engineers, 4th Revised edition 1987, E. Arnold.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://drive.google.com/file/d/1zKi0psulXBNLQux7CZnrFIjxfJ3NWoRb/view?usp=share_link
2	https://drive.google.com/file/d/1uVUHGG8-2vWahUnuBEE6rjAFeLZtJNnI/view?usp=share_link

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=vkraap0k6FE
2.	https://www.youtube.com/watch?v=cJm-jeb_c9U
3.	https://www.youtube.com/watch?v=2IHhIEfzoOo

III SEMESTER

22ME304 : Lab. Material Science and Metallurgy

Course Outcomes

Upon successful completion of the course the students will be able to

1. Distinguish between ferrous and Non-ferrous materials. Illustrate crystal structures for various materials and Differentiate or Distinguish between ferrous and Non-ferrous materials.
2. Interpret Iron-Iron carbide equilibrium diagram and analyse microstructure, general properties of commercial steels and Cast Iron.
3. Discuss the various heat treatment processes for steels.
4. Demonstrate the basics of powder Metallurgy for powder metallurgical components.

Minimum Five Practical's to be performed from the list as below.

SN	**Experiments based on**
1	Study of Metallurgical Microscope.
2	Preparation of Specimen for metallographic examinations.
3	Study and drawing of microstructures of Steels.
4	Study and drawing of microstructures of Cast Iron
5	Study and drawing of microstructures of Non Ferrous Metals.
6	Study of the effect of annealing and normalizing on properties of steels.
7	Determination of hardenability of steels by Jominy End Quench test.
8	Measurement of hardness of ferrous and non-ferrous materials with the help of Brinell hardness tester.
9	Measurement of hardness of ferrous and non-ferrous materials with the help of Rockwell hardness tester.
10	Study the heat treatment of high speed steels.
11	Study of mechanisms of quenching.
12.	Study of Pack carburizing of steel samples.
13.	Study of effect of alloying elements on properties of steel.

III SEMESTER
22ME305 : MANUFACTURING PROCESSES

Course Outcomes :

Upon successful completion of the course the students will be able to

1. **Illustrate** the basics of moulding process and compare various casting processes.
2. **Analyze** various Forming processes and familiar with **design** of dies.
3. **Explain and Distinguish** different welding processes.
4. **Describe** unconventional machining processes.

Unit I: Casting Process	**(8 Hrs.)**

Introduction, Pattern making: Types, materials used, Pattern making allowances, color codes. Core making: - Types, core material & its properties.
Molding: Types of sand moulds, molding sand composition, molding sand properties, molding machines. Gating design – Elements of gating systems, pouring time.
Contemporary Issues related to Topic

Unit II: Special casting processes	**(6 Hrs.)**

Special casting processes such as investment Casting, Centrifugal Casting, Shell Molding, CO Molding, Slush Casting, Die Casting.
Casting inspection & casting defects.
Contemporary Issues related to Topic

Unit III: Mechanics of forming processes	**(6 Hrs.)**

Mechanics of forming processes (including analytical treatment) such as Rolling,Forging, Extrusion & Wire Drawing.
Melting furnaces –Types, Electric furnace, Induction furnace, Cupola-construction & operation.
Contemporary Issues related to Topic

Unit IV: Sheet Metal Working	**(6 Hrs.)**

Sheet Metal Working, Terminology, Types of Operation, Classification of Dies .
Types of Presses , Introduction to Design Parameters (including analytical treatment)
Contemporary Issues related to Topic

Unit V: Joining processes	**(9 Hrs.)**

Joining processes: Introduction to Welding, Soldering,Brazing Processes. Types of Welding, Arc Welding & Gas Welding Processes, Defects & Inspection of Welding Joints, Electrodes, Weldability of Metals, Welding equipments.
Advance WeldingMethods: Introduction to TIG, MIG, spot welding, Plasma Arc welding, Electron Beam, and Electron Laser Beam welding.
Contemporary Issues related to Topic

Unit VI: Nonconventional Machining Processes	(7 Hrs.)
Nonconventional Machining Processes: Characteristics, Operation, applications, Limitation and selection o f process parameters of the following processes, Abrasive Jet Machining, Ultrasonic Machining, Water Jet Machining, EDM, and ECM.	
Total Lecture	**42 Hours**

Textbooks:	
1.	P.n.Rao, Manufacturing TechnologyForming & Welding)), ed 2009, Tata Mc. Grew Hill Education Pvt. Ltd., New Delhi, 2009.
2.	Ghosh and Malik ,Manufacturing Science,East West Second edition,2010.
3.	Hajra Choudhary, Workshop Technology (Volume-I), The McGraw-Hill Companies2nd ED-2010

Reference Books:	
1.	S Kalpakjian &Schmid ,Manufacturing Engineering & Technology, Pearson education Canada. 2 ed 2010
2.	W Chapman, Workshop Technology: Vol. I –III, St. Martin's Press, 5 ed 2019.
3.	M Begman,ManufacturingProcesses, Ballinger Pub. Co

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/SUPPORTED%20FILE/SUPPORTED%20file/SERIES20WISE%20BOOKS/MECHANICAL%20ENGINEERING
2	
3	

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/112/107/112107083/
2.	https://www.youtube.com/watch?v=Xf08dgnlwXg
3.	https://nptel.ac.in/courses/112107089

III SEMESTER
22ME306 : Lab. : MANUFACTURING PROCESSES

Course Outcomes
Upon successful completion of the course the students will be able to
1. Illustrate the basics of moulding practices and various casting process .
2 Analyze various Forming processes and familiar with working of dies.
3 Evaluate different welding processes.
4 Describe unconventional machining processes.

Minimum Eight Practical's to be performed from the list as below

SN	Experiments based on
1	Study of various moulding processes along with preparation of moulding sand.
2	Preparation of wooden pattern in pattern making shop along with study of different types of wooden pattern.
3	To determine grain fineness number of given moulding sand.
4	Demonstration of mould making along with study of foundry tools.
5	Preparation of mould cavity along-with steps involved in mould making.
6	Study of various types of melting furnaces and cupola in detail.
7	Preparation of job on punching press and design of blanking and piercingdie.
8	Performance on various welding machines such as MIG, TIG along-withstudy of different welding processes.
9	Preparation of casting job along-with study of different casting processes.
10	Report/Case Study of foundry visit.
11	**A Visit:** A visit to a foundry shop for more understanding of the casting practices

III SEMESTER
22ME307 : KINEMATICS OF MACHINERY

Course Outcomes :

Upon successful completion of the course the students will be able to

1. Intrepret the various kinematic concepts in different mechanisms.
2. Analyze the velocity and acceleration of links at any point in various mechanisms.
3. Construct the various cam profiles manually in accordance to the follower motion
4. Solve the problems related to gear and gear trains.

Unit I: Simple mechanisms	**(7 Hrs.)**

Basic concept of mechanism, link, kinematics pairs, kinematics chain, mechanism, machine, simple & compound chain, Degree of freedom, estimation of degree of freedom of mechanism by Grubber's criterion and other methods. classification of four bar chain [class-I & Class-II], inversion of four-bar-chain, Kutchbach theory of multiple drives,

Contemporary Issues related to Topic

Unit II: Quantitative kinematics analysis of mechanism	**(6 Hrs.)**

Displacement, Velocity and Acceleration analysis of planer mechanism by graphical method as well as analytical method [complex number method/matrix method], Instantaneous center method, Kennedy's theorem

Contemporary Issues related to Topic

Unit III: Cams and followers	**(7 Hrs.)**

Concepts of cam mechanism, comparison of cam mechanism with linkages. Types of cams and followers and applications.

Synthesis of cam for different types of follower motion like constant velocity, parabolic, SHM, cycloid etc. Analysis of follower motion for cams with specified contours like eccentric cam, tangent cam and circular arc cam with concave and convex curvature. Pressure angle in cam, parameters affecting cam performance

Contemporary Issues related to Topic

Unit IV: Gears	**(6 Hrs.)**

Concept of motion transmission by toothed wheels, comparison with cams and linkages, various tooth profiles, their advantages and limitations, gear tooth terminologies, concept of conjugate action, law of conjugate action, kinematics of in volute gear tooth pairs during the contact duration, highlighting locus of the point of contact, arc of contact, numbers of pairs of teeth in contact, path of approach and path of recess, interference, undercutting for in volute profile teeth

Contemporary Issues related to Topic

Unit V: Gear Trains	**(7 Hrs.)**

Kinematics of helical, bevel, spiral, worm gears, rack and pinion gears, kinematics analysis, and torque analysis of simple epicyclical and double epicyclical gear trains

Contemporary Issues related to Topic

Unit VI: Static force analysis	(6 Hrs.)
Free body diagram, condition of equilibrium. Analysis of all links of given linkage, cam, gear mechanism and their combinations without friction	
Total Lecture	**39 Hours**

Textbooks:	
1.	shigley., Theory of Machines and Mechanism
2.	Ghosh and Malik Theory of Machines and Mechanism
3.	S.S.Ratan Theory of Mechanism.

Reference Books:	
1.	Rao & Dukipatti ,Mechanism and Machine Theory
2.	Khurmi and Gupta,Theory of machines
3.	Thomson W T,Theory of machines

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://drive.google.com/drive/folders/1QxdRbGdmv3A7or3oTElz78ao1oDDrbJX?usp=share_link
2	https://drive.google.com/drive/folders/1wkyz1ZNhhY4T4-MfLsCC9mjZ2xihGgr7
3	https://drive.google.com/drive/folders/1wkyz1ZNhhY4T4-MfLsCC9mjZ2xihGgr7

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112105268
2.	https://nptel.ac.in/courses/112104121
3.	https://nptel.ac.in/courses/112/104/112104121/

III SEMESTER
22ME308 : MECHANICS OF MATERIALS

Course Outcomes :

Upon successful completion of the course the students will be able to

CO1: Apply the basic concepts of stress, strain and their variations under different types of loading to calculate Stresses.

CO2: Construct bending moment, shear force diagram for statically determinate beams and determine stress distribution.

CO3: Compute slope and deflection in statically determinate beam and calculate strain energy under varying load conditions.

CO4: Evaluate the torsional shear stress in shaft and examine the buckling failure in columns

Unit I: Concept of simple stresses and strains **(7 Hrs.)**

Concept of simple stresses and strains: Introduction, Stress, strain, types of stresses, stress - strain diagram for brittle & ductile material, elastic limit, Hooks law, modulus of elasticity, modulus of rigidity, factor of safety, analysis of tapered rod, analysis of composite section, thermal stress and strain, thermal stresses with heat flow in cylinders and plates, Hertz's contact stresses. Longitudinal strain & stress, lateral stresses and strains, Poisson's ratio, volumetric stresses and strain with uni-axial, bi-axial & tri-axial loading, bulk modulus, relation between Young's modulus and modulus of rigidity, Poisson's ratio and bulk modulus. **[CO-1]**

Contemporary Issues related to Topic

Unit II: Shear force and bending moments in Beam **(6 Hrs.)**

Shear force and bending moments in Beam: Types of beam (cantilever beam, simply supported beam, overhung beam etc.), Types of loads (Concentrated and UDL), shear force and bending moment diagrams for different types of beams subjected to different types of loads, sign conventions for bending moment and shear force, shear force and bending moment diagrams for beams subjected to couple, Relation between load, shear force and bending moment. **[CO-2]**

Contemporary Issues related to Topic

Unit III: Stresses in beams **(7 Hrs.)**

Stresses in beams: Pure bending, theory of simple bending with assumptions & expressions for bending stress, derivation of bending equation, bending stresses in symmetrical sections, section modulus for various shapes of beam sections.

Shear stresses in beams: - Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress. **[CO-2]**

Contemporary Issues related to Topic

Unit IV: Deflection of beams and Strain energy and impact **(6 Hrs.)**

Deflection of beams: Derivation of differential equation of elastic curve, Deflection & slope of cantilever, simply supported, overhung beams subjected to concentrated loads, UDL, Relation between slope, deflection & radius curvature McCauley's method, area moment method to determine deflection of beam.

Strain energy and impact: Concept of strain energy, derivation and use of expressions for deformation of axially loaded members under gradual sudden and impact loads. Strain energy stored in bending & torsion. Castingliano's theorem. **[CO-3]**

Contemporary Issues related to Topic

Unit V: Torsion of circular shafts, Column & Struts	(7 Hrs.)
Torsion of circular shafts: Derivation of torsion equation. Torsional shear stress induced in the shaft, when it is subjected to torque. Torque transmitted by solid & hollow circular shaft. Derivation of maximum, minimum principal stresses and maximum shear stress induced in shaft when it is subjected to bending moment, torque & axial load. **Column & Struts:** Failure of long & short column, slenderness ratio, Euler's column theory, End conditions for column. Expression for crippling load for various end conditions of column. Effective length of column, limitations of Euler's formula, Rankine formula, Johnson's parabolic formula. **[CO-4]** **Contemporary Issues related to Topic**	
Unit VI: Combined Stresses:	**(6 Hrs.)**
Combined Stresses: Definition of principal planes & principal stresses, analytical method of determining stresses on oblique section when member is subjected to direct stresses in one plane in mutually perpendicular two planes, when member is subjected to shear stress and direct stresses in two mutually perpendicular planes, Mohr's circle for representation of stresses. Derivation of maximum and minimum principal stresses & maximum shear stresses when the member is subjected to different types of stresses simultaneously (i.e. combined stress) **[CO-1]** **Contemporary Issues related to Topic**	
Total Lecture	**39 Hours**

Textbooks:	
1.	Strength of Materials, Ramamrutham S., 16th Edition (2010) , Dhanpat Rai Publishing
2.	Strength of Materials Beer and Johnston 4th Edition (2009) McGraw-Hill
3.	Popov E. P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 2007.

Reference Books:	
1.	Strength of Materials Timoshenko and Young Seventh Edition1984 , CSB Publisher
2.	Applied Strength of Materials, Sixth Edition SI Units Version, Robert L. Mott, Joseph A. Untener, CRC Press, 2017
3.	Subramanian R., "Strength of materials", 2nd Edition (2010) Oxford University Press, New Delhi,
4.	Shames I.H. "Introduction to Solid Mechanics", PHI Publication, 3rd Edition, 2002
5.	William A.Nash, "Theory and Problems of Strength of materials, Schaum's Outline series", Tata McGraw-Hill, New Delhi, 2007.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112107146
2.	https://nptel.ac.in/courses/112106141
3.	https://archive.nptel.ac.in/courses/105/105/105105108/

III SEMESTER
22ME309 : Lab. MECHANICS OF MATERIALS LAB

Course Outcomes
Upon successful completion of the course the students will be able to **CO1:** Apply the basic concepts of stress, strain and their variations under different types of loading to calculate Stresses. **CO2:** Construct bending moment, shear force diagram for statically determinate beams and determine stress distribution. **CO3:** Compute slope and deflection in statically determinate beam and calculate strain energy under varying load conditions. **CO4:** Evaluate the torsional shear stress in shaft and examine the buckling failure in columns

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Demonstration of UTM
2	Tension test on a mild steel rod
3	Compression test on Aluminium specimen
4	Hardness test on metals with Rockwell Hardness tester
5	Flexure test on Wooden beam
6	Spring stiffness test
7	Torsion test on mild steel rod
8	Impact Test
9	Demonstration of Fatigue Test

III SEMESTER

22ME310 : Environmental Sustainability, Pollution and Management

Course Outcomes:

Upon successful completion of the course, the students will be able to

The student will be able to

1. Gain insights into the efforts to safeguard the Earth's environment and resources.
2. Develop a critical understanding of the contemporary environmental issues of concern
3. Have an overview of pollution, climate change and national and global efforts to address adaptation and mitigation to changing environment through environmental management.
4. Learn about the major international treaties and our country's stand on and responses to the major international agreements.

Unit:1	**Environment, Natural Resources and Sustainable Development**	**6 Hours**
The man-environment interaction; Environmental Ethics and emergence of environmentalism; Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, water, soil and mineral resources, renewable, and non-renewable energy resources; Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs		
Unit:2	**Environmental Issues, Conservation of Biodiversity and Ecosystems**	**6 Hours**
Environmental issues and scales: Land use and Land cover change, Global change; Biodiversity and its distribution, Ecosystems and ecosystem services, Threats to biodiversity and ecosystems, National and international policies for conservation.		
Unit:3	**Environmental Pollution and Health**	**7 Hours**
Understanding pollution: Production processes and generation of wastes, Air pollution, Water pollution, Soil pollution and solid waste, Noise pollution, Thermal and Radioactive pollution. Impact on human health		
Unit:4	**Climate Change: Impacts, Adaptation and Mitigation**	**7 Hours**
Understanding climate change, Impacts, vulnerability and adaptation to climate change, Mitigation of climate change		
Unit:5	**Environmental Management**	**7 Hours**
Environmental management system: ISO 14001, Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis, Environmental audit and impact assessment; Waste Management and sustainability; Ecolabeling /Eco mark scheme		
Unit :6	**Environmental Treaties and Legislation**	**6 Hours**
Introduction to environmental laws and regulation, An overview of instruments of international cooperation, Major International Environmental Agreements, Major Indian Environmental Legislations, Major International organizations, and initiatives		
	Total Lecture	**39 Hours**

Text books	
1	Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson
2	Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press
3	Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
4	Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education
5	Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
6	Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press
7	Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press
Reference Books	
1	Headrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press
2	Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
3	William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
4	Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
5	Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards
6	Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213
7	Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press
8	Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf

Audit Course
III SEMESTER
MLC2123:

Audit Course
III SEMESTER
MLC103: Computer Aided Design

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

4th Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
THIRD SEMESTER															
1	3	BS	GE/MTH	22ME301	Integral Transforms and Partial Differential Equations	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	3	HS	GE/HUM	22ME302	Fundamentals of Management and Economics	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	3	PC	ME/ME	22ME303	Material Science & Metallurgy	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	3	PC	ME/ME	22ME304	**Lab:-** Material Science & Metallurgy	**P**	0	0	2	2	1		60	40	
5	3	PC	ME/ME	22ME305	Manufacturing Process	**T**	3	0	0	3	3	30	20	50	3 Hrs
6	3	PC	ME/ME	22ME306	**Lab:-** Manufacturing Process	**P**	0	0	2	2	1		60	40	
7	3	PC	ME/ME	22ME307	Kinematics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	3	PC	ME/ME	22ME308	Mechanics of Materials	**T**	3	1	0	3	3	30	20	50	3 Hrs
9	3	PC	ME/ME	22ME309	**Lab:-** Mechanics of Materials	**P**	0	0	2	2	1		60	40	
10	3	PC	CV/EL	22ME310	Environmental Sustainability, Pollution and Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
						TOTAL	**21**	**1**	**6**	**27**	**24**				
List of Mandatory Learning Course (MLC)															
1	3	HS	GE/T&P	MLC2123	YCAP3 -	**A**	3	0	0	3	0				
2	3	HS	ME	MLC103	Computer Aided Design	**A**	2	0	0	2	0				
FOURTH SEMESTER															
1	4	BS	ME/ME	22ME401	Production Management	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	4	PC	ME/ME	22ME402	Design of Machine Elements	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	4	PC	ME/ME	22ME403	Engineering Thermodynamics	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	4	PC	ME/ME	22ME404	Fluid Mechanics	**T**	3	1	0	3	4	30	20	50	3 Hrs
5	4	PC	ME/ME	22ME405	**Lab:-** Fluid Mechanics	**P**	0	0	2	2	1		60	40	
6	4	PC	ME/ME	22ME406	Dynamics of Machines	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	4	PC	ME/ME	22ME407	**Lab:-** Dynamics of Machines	**P**	0	0	2	2	1		60	40	
8	4	PC	ME/ME	22ME408	Metrology & Quality control	**T**	3	0	0	3	3	30	20	50	3 Hrs
9	4	PC	ME/ME	22ME409	**Lab:-** Metrology & Quality control	**P**	0	0	2	2	1		60	40	
						TOTAL	**18**	**1**	**6**	**24**	**22**				
List of Mandatory Learning Course (MLC)															
1	4	HS	GE/T&P	MLC2124	YCAP4 -	**A**	3	0	0	3	0				
2	4	HS	ME	MLC104	MATLAB for Mechanical Engineering	**A**	2	0	0	2	0				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : TA1-5 marks on Proctored Online Exam, TA2-12 marks on activitied decided by course teacher, TA3 - 3 marks on class attendance

TA = for Practical : MSPA will be 15 marks each**

		June 2022	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

IV SEMESTER
22ME401 : Production Management.

Course Outcomes :
Upon successful completion of the course the students will be able to 1. Estimate, evaluate and analyze the production system using work study. 2. Design and evaluate plant layouts. 3. Able to predict and evaluate future demand using forecasting 4. Estimate production costing and apply by judging production planning and control.

Unit I: Work Study	**(7 Hrs.)**
Productivity, factors affecting productivity. Measurement of productivity. Work study and methods study: Definitions, objectives, steps in method study, Process charts, string diagram, motion study, micro motion study, SIMO Chart. **Contemporary Issues related to Topic**	
Unit II: Work Measurement	**(8 Hrs.)**
Objectives, definition, stop watch study, work sampling, PMTs, MTM & Work factor method. Value analysis and value Engineering:, Introduction, steps involved in value analysis. Applications in Manufacturing. **Contemporary Issues related to Topic**	
Unit III: Plant Layout	**8 Hrs.)**
Types of Plant Layout, Layout Functions and problems, Organization, Automated material handling, Concepts of AGVs, AS/RS and other automated devices. Design of integrated plant layout for product handling system. **Contemporary Issues related to Topic**	
Unit IV: Forecasting:	(7 Hrs.)
Need for forecasting, classification of forecasting methods, like judgmental technique, time series analysis, least square method, moving average method, exponential smoothing method. **Contemporary Issues related to Topic**	
Unit V: Production planning and control	**(7 Hrs.)**
Definition, objectives of PPC, functions of PPC, types of production, Inventory control, EOQ, Techniques in inventory control, and associated problems. **Contemporary Issues related to Topic**	
Unit VI: Process analysis and Cost Estimation:	**(8 Hrs.)**
Steps involved in manual production planning, Selection of process, and analysis. Aims of Cost Estimation, Difference between cost and Estimation, Elements of cost: material, Product cost, Analysis of overhead expenses, Product cost estimation **Contemporary Issues related to Topic**	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	George Kanawaty., Introduction to Work study, 4 th Edition (1992), ILO
2.	M Mahajan, PPC,Dhanpat rai and co, Jan 2018.
3.	Sharma,P.C , Production Engineering, Scc , New Delhi

Reference Books:	
1.	I Telsang, M. ,Delhi , Industrial Engineering And Production Management / Telsang, Delhi: S.Chand & Co., 2009
2.	Murell, Ergonomics, first edition 1985, Chapman & Hall
3.	Barnes., Motion and Time study first edition 1980, Wiley

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(E%20Series).pdf
2	https://drive.google.com/drive/folders/1QxdRbGdmv3A7or3oTElz78ao1oDDrbJX?usp=share_link

MOOCs Links and additional reading, learning, video material	
1	https://www.youtube.com/watch?v=zWQovrjB7Uc&list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb
2	https://www.youtube.com/watch?v=zczDG6vsZl0&list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb&index=5
3	https://www.youtube.com/watch?v=y6NKspIn2XE&list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb&index=11
4	https://www.youtube.com/watch?v=Z6QBcC_mb4M

IV SEMESTER

22ME402 : Design of Machine Elements

Course Outcomes :
Upon successful completion of the course the students will be able to 1. **Apply** knowledge of design principal in various machine components. 2. **Analyze** the design process of various joints i.e., Welded joints, Bolted joints and Riveted joints. 3. **Evaluate** the design and failure criteria of power screws, springs, clutches and brakes. 4. **Analyze** the design process of pressure vessels, power transmission shafts and find its failure criteria.

Unit I: Introduction of Design of machine Elements	**(6 Hrs.)**
Definition of design, types of design, design process, need, defining the problem, feasibility, design alternatives, final design selection, preliminary and final plant drawings. Theories of failure, Design for Fatigue & manufacturing considerations in design, basis of good design, failure of machine parts, Mechanical properties, Design considerations and selection of materials. **[CO – 1]** **Contemporary Issues related to Topic**	
Unit II: Design of Joints:	**(7 Hrs.)**
Welded joint: design of single transverse, double transverse, parallel fillet, combination fillet butt joint, eccentrically loaded welded joints. Bolted joint: Design of bolted fasteners, a bolt of uniform strength, bolted joints under eccentric loading. Design of riveted joints.**[CO – 2]** **Contemporary Issues related to Topic**	
Unit III: Power screw and Leaf spring	**(7 Hrs.)**
Design of power screw Design of Helical and Leaf Springs.**[CO – 3]** **Contemporary Issues related to Topic**	
Unit IV: Brakes and clutches	**(6 Hrs.)**
Kinematics of Friction Drives such as Brakes, Clutches Design of Friction Clutch, Single Plate, Multiple Plate, Cone, Centrifugal Clutch, Design of Brake, Shoe Brake, Band Brake,, Internal Expanding brake.**[CO – 3]** **Contemporary Issues related to Topic**	
Unit V: Pressure Vessel	**(6 Hrs.)**
Classification of Thick and Thin Cylindrical Pressure Vessel, Stresses in Thin and Thick Cylindrical Pressure Vessels when it is subjected to internal pressure, Expression for Circumferential and Longitudinal stresses, Design of pressure vessel, Heads and Cover Plate.[**CO – 4]** **Contemporary Issues related to Topic**	
Unit VI: Design of Shafts:	**(7 Hrs.)**
Design of transmission Shafts on the Basis of Strength and rigidity, ASME Code for shaft Design, Design of Stepped shaft Axle splined Shaft, Keys.[CO – 4] **Contemporary Issues related to Topic**	
Total Lecture	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Mechanical Engg. Design, Shigley J. E, 7 th Edition. 2000, McGraw-Hill
2.	Design of Machine Element, Bhandari V.B., 5th Edition, McGraw-Hill
3.	Machine Design, U. C. Jindal, 2010, Dovling Kinderslay

Reference Books:	
1.	Mechanical Design of Machine, Maleev Hartman, 5th Edition, Cbs Publishers & Distributors
2.	Design Data Book, Shiwalkar B. D, 7th Edition, PSG Tech, Coimbatore, India
3.	Design of Machine Element, Shiwalkar B. D, 3rd Edition 2008, , PSG Tech, Coimbatore, India

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(E%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(G%20Series).pdf

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=K0CgcBYYHA4&list=PLiSPNzs4fD9sZKMUSbSzcb9iAMBX2mQj1
2.	https://www.youtube.com/watch?v=EFeDKFzmAjg&list=PLiSPNzs4fD9tr-0dNHGrnKwETw2OKft39
3.	https://www.youtube.com/watch?v=hYGEBQphtkw&list=PLiSPNzs4fD9s131_cBI_G4DLkG-GrinLb
4	https://archive.nptel.ac.in/courses/112/105/112105124/
5.	https://www.coursera.org/learn/machine-design1?utm_source=gg&utm_medium=sem&utm_campaign=B2C_INDIA__branded_FTCOF_courseraplus_arte_PMax&utm_content=Degree&campaignid=19607944793&adgroupid=&device=c&keyword=&matchtype=&network=x&devicemodel=&adpostion=&creativeid=&hide_mobile_promo&gclid=Cj0KCQjwk7ugBhDIARIsAGuvgPaVoxNd2PPS5hLdoOuqjOqSSqDeanb3fiBDqcx-UlwWiMFDUfXRvrkaAu2yEALw_wcB

IV SEMESTER
22ME403 : Engineering Thermodynamics

Course Outcomes :

Upon successful completion of the course the students will be able to

1) Apply the First and zeroth law of thermodynamics for the analysis of thermodynamic systems to evaluate energy interaction in various processes.
2) Evaluate the performance of cyclic devices, change in the entropy and availability in various processes applying the laws of thermodynamics.
3) Evaluate various thermodynamic parameters in various processes with phase change using phase change diagrams, relations and steam tables/ charts applying Law of thermodynamics.
4) Analyze the performance of various Thermodynamic cycles applying Law of thermodynamics for evaluation of energy interaction.

Unit I: Introduction to Thermodynamics:	**(7 Hrs.)**

Basic concepts of Thermodynamics, Continuum and macroscopic approach; thermodynamic system, Concept of energy and various forms of energy; internal energy, enthalpy; specific heats; thermodynamic properties and equilibrium; state of a system, state postulate, state diagrams, paths / processes and cycles on state diagrams. The Ideal Gas equation of state.
The concepts of heat and work interactions. Evaluation of different modes of work.
Zeroth Law of Thermodynamics, concept of temperature.
Contemporary Issues related to Topic

Unit II: First Law of Thermodynamics	**(6 Hrs.)**

First Law of Thermodynamics applied to the various processes in Closed Systems, Various Steady flow systems, Steady-Flow Engineering Devices .
Contemporary Issues related to Topic

Unit III: Second Law of Thermodynamics	**(7 Hrs.)**

Second Law of Thermodynamics:
Limitations of the Zeroth and First law of thermodynamics,
concepts of Thermal energy reservoirs, heat engines and heat pumps/refrigerators,
Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes;
Carnot cycle and Carnot principles/theorems; thermodynamic temperature scale.
Contemporary Issues related to Topic

Unit IV: Entropy	**(6 Hrs.)**

Entropy:
Clausius inequality and concept of entropy; microscopic interpretation of entropy, the principle of increase of entropy, T-s diagrams, Change in entropy for processes in Closed and Steady flow systems.
Introduction to concept of Availability.
Contemporary Issues related to Topic

Unit V: Properties of Pure Substances (Steam)	(7 Hrs.)
Properties of Pure Substances (Steam): Thermodynamic properties of pure substances in solid, liquid and vapor phases; P-v-T behavior of simple compressible substances, phase rule, thermodynamic property tables (Steam Tables) and charts. Calculations of work and heat interactions in non- flow and steady flow processes. Determination of dryness fraction using various calorimeters. **Contemporary Issues related to Topic**	
Unit VI: Thermodynamic Cycles	**(6 Hrs.)**
Thermodynamic Cycles **Vapor Power Cycles**: Carnot vapor cycle, Rankine cycle: ideal and the reheat, the analysis of vapor power cycle. **Air-standard cycles:** air standard assumptions, basic considerations and the analysis of power cycles: Otto cycle, Diesel engine cycle, and Brayton cycle. **Contemporary Issues related to Topic**	
Total Lecture	**39 Hours**

Textbooks:	
1.	Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi.
2	Cengel, „Thermodynamics – An Engineering Approach" Tata McGraw Hill, New Delhi.
3	Reiner Joel., Basic Engineering Thermodynamics, Longman Publications.Nelson A., Engineering Mechanics (Statics and Dynamics), ed 2009, Tata Mc. Grew Hill Education Pvt. Ltd., New Delhi, 2009.

Reference Books:	
1.	Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley.
2.	Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of Engineering Thermodynamics: John Wiley & Sons.

MOOCs Links and additional reading, learning, video material	
1.	https://classroom.google.com/c/NDczMzgwNTQ5OTE1

IV SEMESTER
22ME404 : Fluid Mechanics

Course Outcomes :
Upon successful completion of the course the students will be able to
i) Develop an understanding of fluid statics, kinematics and dynamics in Mechanical.
ii) Learn to apply Bernoulli's Equation and momentum equation to Fluid flow systems.
iii) Study various flow measuring devices.
iv) Understand the concept of viscosity as applied in real flows.
v) Learn to use equations in combination with experimental data to determine losses in flow systems.

Unit I	**(9 Hrs.)**
Introduction to Fluid Mechanics: Definition of Fluid, Properties of fluids, Newton's law of viscosity, Pascal's law, Basic equation of fluid static, Pressure variations in compressible & incompressible fluids, Fluid pressure & its measurement (Manometers & Bourdon's pressure gauge), Hydrostatics: Forces on submerged plane surfaces **Contemporary Issues related to Topic**	
Unit II	**(7 Hrs.)**
Kinematics Of Fluid Flow: Types of flow, Stream line, Path line, Streak line, Stream tube, Continuity equation, One and Two dimensional flow, Velocity and Acceleration at a point, Circulation and Vorticity, Stream function and Velocity potential. **Contemporary Issues related to Topic**	
Unit III	**(8Hrs.)**
Dynamics Of Fluid Flow: Integral Momentum Equation, One-dimensional method for flow analysis, Impact of jet on stationary and moving Flat and curved vanes, Theory of Rotodynamic machines. **Contemporary Issues related to Topic**	
Unit IV	**(8 Hrs.)**
Derivation of Bernoulli's equation for incompressible flow & its applications for various ideal and practical systems, Venturimeter, Orifice Meter and Pitot tube **Contemporary Issues related to Topic**	
Unit V	**(8 Hrs.)**
Viscous Flow: Newton's law of viscosity and its applications, Introduction to laminar and turbulent flow through pipes, Reynolds number and its significance, Boundary layer concept, Wall shear and boundary layer thickness, Kinetic energy correction factor, Momentum energy correction factor, Drag and Lift on immersed bodies. **Contemporary Issues related to Topic**	
Unit VI	**(8 Hrs.)**
Flow Through Pipes: Equations for pipe flow, Friction charts and their uses, Losses in pipes and fittings, Hydraulic gradient lines and total energy lines, Pipes in series and parallel. Siphon, Water hammer phenomenon, Economics of pipe systems. Power Transmission Through Pipeline: Condition for maximum power transmission through a given pipeline (single pipe), Relationship of nozzle diameter to pipe diameter for maximum power transmission. **Contemporary Issues related to Topic**	
Total Lecture	**48 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	D. S. Kumar, Fluid Mechanics & Fluid Power Engineering, S. K. Kataria Publication
2	C.P. Kothandaraman & R. Rudramoorthy, Basic Fluid Mechanics, New Age Publication
3	K. L. Kumar, Engineering Fluid Mechanics, S. Chand Company

Reference Books:	
1.	Yunus A. Cengel and John M. Cimbala, Fluid Mechanics*:* Fundamentals and Applications, McGraw-Hill
2	J.F.Douglas, J.M.Gasiorek & J.A. Swaffield, Fluid Mechanics, ELBS Publication

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	

MOOCs Links and additional reading, learning, video material	
1.	Hydraulic Statics: https://youtu.be/fa0zHI6nLUo
2	Kinematics: https://youtu.be/5H0euuo1PGQ
3.	Fluid Dynamics: https://youtu.be/lGL7Dp8xK_U

IV SEMESTER
22ME405 : Lab. Fluid mechanics…

Course Outcomes
Upon successful completion of the course the students will be able to 1. Develop an understanding of fluid statics, kinematics and dynamics in Mechanical. 2. Learn to apply Bernoulli's Equation and momentum equation to Fluid flow systems. 3. Study various flow measuring devices. 4. Understand the concept of viscosity as applied in real flows. 5. Learn to use equations in combination with experimental data to determine losses in flow systems.

Minimum Eight Practical's to be performed from the list as below

SN	Experiments based on
1	Study of Pressure Measuring Devices**[CO:1]** a) Manometer i) Single Tube Manometer ii) U-tube Manometers • Double U-tube Manometers • Well type U tube Manometers iii) Differential U-tube Manometers • Upright U-tube Manometers • Inverted U-tube Manometers. b) Bourdon gauge c) Diaphragm Guages d) Bellow Guages
2	To Determine Coefficient of Discharge of Rectangular Notch**[CO:3]**
3	To Determine Coefficient of Discharge of Triangular notch**[CO:3]**
4	To Determine Coefficient of Discharge of Open Orifice **[CO:3]**
5	Verification of Bernoulli's Equation[CO:3]
6	To Determine Coefficient of Discharge of Venturimeter[CO:3]
7	To Determine friction factor of fluid flowing through pipe[CO:4]
8	To Determine Minor losses and Coefficients of Minor Losses [CO:4]
9	To Determine Coefficient of Discharge of Orificemeter [CO:3]
10	Report on Project based learning

IV SEMESTER
22ME406 : Dynamics of Machines

Course Outcomes :

Upon successful completion of the course the students will be able to

1. Apply the knowledge of basic Mechanism and Differentiate static and dynamic forces on different machines and mechanisms.
2. Analyze the unbalanced in rotating & reciprocating machines and corrections required to balance the same.
3. Identify and analyze the vibrations in different machines.
4. Evaluate and justify vibrations through Mathematical solution.

Unit I: Introduction	**(7 Hrs.)**
D"Alembert principle, Dynamic force analysis of simple mechanism Gyroscope: simple precession and gyroscopic couple, gyroscopic effect on airplane, ship, vehicles and grinding mills (CO-1) **Contemporary Issues related to Topic**	
Unit II: Governors	**(6 Hrs.)**
Classification, Watt, Portal, Proell, Hartnell governors etc, Flywheel: Turning moment Vs crank angle diagram for single- cylinder and multiple-cylinder engines, punching machines etc. Flywheel selection (CO-1) **Contemporary Issues related to Topic**	
Unit III: Balancing in rotating mechanism	**(7 Hrs.)**
Static & Dynamic balancing in rotating masses, balancing of multiple masses rotating in same plane, Balancing of several masses rotating in different planes, Dynamic balancing machine (CO2) **Contemporary Issues related to Topic**	
Unit IV: Balancing of reciprocating masses	**(6 Hrs.)**
Primary and secondary unbalanced forces of reciprocating masses. Partial balancing of unbalanced primary forces in a reciprocating engine. Balancing of primary and secondary force and couples in multiple inline engine, Balancing of radial engines (Direct and reverse crank method) (CO2) **Contemporary Issues related to Topic**	
Unit V: Vibration	**(7 Hrs.)**
Derivation of equation of motion for vibratory system. Free vibration of single-degree-of-freedom system with and without damping. Logarithmic decrement and damping estimation. Forced vibration of single-degree-of-freedom and vibration isolation, whirling of shaft and critical speed of rotors (CO3,CO4) **Contemporary Issues related to Topic**	
Unit VI: Torsional vibration	**(6 Hrs.)**
Torsional Vibration of single rotor, two-rotor and three rotors, Natural frequencies and mode shapes, Torsionally Equivalent System,Free Torsional Vibration of Geared System.,Lagranges equations and introduction to multi degree freedom systems Equation of motion for Two-degree-of-freedom system (CO3,CO4) **Contemporary Issues related to Topic**	
Total Lecture	**39 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Theory of Machines and Mechanism Shigley 4 Edition (2009) Oxford University
2.	Theory of Machines and Mechanism, Ghosh & Mallik 2 Edition (1999) Affiliated East-West
3.	Theory of Mechanism, Rattan S. S 2 Edition (2005) Tata McGraw-Hill .
4.	Mechanism and Machine Theory, Rao & Dukipatti y 3rd edition 2004 Wiley & Sons

Reference Books:	
1.	Theory of Machine 3 rd Edition (2009) Thomas Bevan Pearson Education
2.	Theory of Machines 4 th Edition (2006) Sandor & Erdman Prentice Hall
3.	Mechanical vibrations 3 rd Edition (2009) Grover M.P prentice hall of India
4.	Theory of Machine 3 rd Edition (2009) Thomas Bevan Pearson Education
5.	Theory of Vibrations 2 nd edition 1995 Thomson W T Prentice Hall of India

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/
2	https://drive.google.com/drive/folders/1QxdRbGdmv3A7or3oTElz78ao1oDDrbJX?usp=share_link

MOOCs Links and additional reading, learning, video material	
1.	
2.	
3.	

IV SEMESTER
22ME407: Lab. Dynamics of Machines

Course Outcomes
Upon successful completion of the course the students will be able to 1. To enables the students to analyze dynamic forces and couples in machine and mechanism 2. To introduce the concept of unbalanced forces need for balancing of various machines and the different ways to achieve balancing. 3. To impart elementary knowledge of vibrations, and To prepares students for calculations of Vibrations important parameters and vibration isolation

Minimum Eight Practical's to be performed from the list as below

SN	**Experiments based on**
1	Study of static and dynamic force analysis
2	Determination of Gyroscopic couple through motorized Gyroscope
3	Experiments on Governors - Pronell Governor, Hartnell Governor
4	Determination of Balancing of rotating mass, statically and dynamically
5	Determination of natural frequency of longitudinal vibration
6	Determination of natural frequency of transverse vibration of beam.
7	Determination of natural frequency of simply supported beam using dunkerlays method.
8	Determination of natural frequency of torsional vibration of single rotor
9	Determination of natural frequency of torsional vibration of double rotor.
10	Determination of whirling speed of shaft.

IV SEMESTER
22ME408: Metrology & Quality Control

Course Outcomes:

Upon successful completion of the course the students will be able to

CO1 - Understand the methods of measurement and selection of measuring instruments, standards of measurement

CO2 - Identify and apply various measuring instruments

CO3 - Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design

CO4 - Mention the Quality Control Techniques and Analyze Statistical Tools appropriately.

Unit:1	Introduction to Engineering Metrology	6 Hours

Principles of Engineering Metrology, Measurement standards, Types and sources of Errors , Precision and Accuracy, Various precision measuring instruments, Straightness, Flatness, Squareness, Roundness , Angular measurement, introduction to uncertainty in measurement, linear and angular measuring instruments and their applications ,Calibration of all measuring instruments. Introduction to Reverse Engineering

Contemporary Issues related to Topic –

Unit:2	Comparators and Surface Texture Measurement	6 Hours

Comparators - Constructional features and operation of mechanical, optical, electrical/electronic and pneumatic comparators, advantages, limitations and field of applications. Principles of interference, concept of flatness, flatness testing, optical flats, optical interferometer and laser interferometer.

Surface Roughness Measurement: Surface texture terminology, Parameters for measuring surface roughness, Contact & non-contact type surface roughness measuring instruments. Surface Texture Measurement - importance of surface conditions, roughness and waviness, surface roughness standards specifying surface roughness parameters- Ra, Ry, Rz, RMS value etc., surface roughness measuring instruments – Tomlinson and Taylor Hobson versions, surface roughness symbols.

Contemporary Issues related to Topic

Unit:3	Metrology of Screw Thread , Gear and Advanced Metrology	7 Hours

Measurement of Thread form: Screw thread terminology, Thread form errors, Measurement of Minor, Major and Effective diameter (Two/Three Wire Method), Flank angle, pitch, measurement by Floating Carriage Micrometer (Numerical)

Gear Metrology: Gear terminology and its measurement, Measurements of tooth thickness by gear tooth vernier caliper, Types of errors, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Profile Projector, Tool makers microscope and their applications.

Advancements in Metrology: Introduction & applications of: Co-ordinate Measuring Machine, Universal Measuring Machine, ,Laser in Metrology, Laser Telemetric system, Scanning Laser gauge Machine vision for online-offine inspection.

Contemporary Issues related to Topic

Unit:4	Design of Gauges.	7 Hours

Limits, fits and tolerances, Tolerance grades, Types of fits, shaft basis system, hole basis system , Interchangeability and selective assembly, allowances.

The basics of Geometric Diamensioning and Tolerancing –GD &T

GO and NO GO gauges- Taylor's principle, design of GO and NO GO gauges(numerical), Types of gauges and gauge design (numerical). Design of tolerance chart (numerical).

Contemporary Issues related to Topic

Unit:5	Introduction to Quality and Quality Control	7 Hours
Introduction to Quality and Quality Tools . Quality: Dimensions, Statements, Cost of quality & value of quality, quality of design .Introduction to Quality Assurance , Quality Circle. Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical) **Contemporary Issues related to Topic**		
Unit :6	**Acceptance Sampling**	**7 Hours**
Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical). Contemporary Issues related to Topic		
Total Lecture Hours		**40Hours**

Textbooks	
1	Engineering Metrology by R.K.Jain , Khanna pub, 21 Edition 2021

Reference Books	
1	Introduction to Statistical Quality Control by Douglas C. Montgomery , Seventh Edition - John Wiley & Sons, 2021
2	ASTME, "Handbook of Industrial Metrology" , Prentice Hall of India Ltd,1967.
3	Hume K.J., "Engineering Metrology" , Macdonald Publications, ISBN no13-978-81-7409-153-X,1984.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/112104250
2	https://nptel.ac.in/courses/112106179
3	https://elearn.nptel.ac.in/shop/nptel/engineering-metrology/

IV SEMESTER
22ME409: Lab. Metrology & Quality Control

Course Outcomes:
Upon successful completion of the course, the students will be able to
CO1- Understand the methods of measurement and selection of measuring instruments, standard of measurement
CO2- Identify and apply various measuring instruments
CO3- Explain tolerance, limits of size, its, geometic and position tolerance and gauge design
CO4- Mention the Quality Control Techniques and Analyze Statistical Tools appropriately

Sr. No.	**Experiments based on**
1	To find half taper angle of a w/p by using sine bar
2	To find various parameters of screw thread by using TMM.
3	To find effective diameter of a threaded plug by two wire method using floating carriage machine.
4	Measurement of flatness of surface using optical flat and monochromatic light.
5	To measure the surface roughness of a given w/p using Stylus probe.
6	To measure the profile/Parameters of given (thread) w/p using optical profile projector.
7	Calibration of all metrological Instruments.
8	Design of Gauges.
9	Find out process capability with the help of control chart.
10	Preparation of OC & AOQ Curve for double sampling plan.

Audit Course
IV SEMESTER
MLC2124:

Audit Course
IV SEMESTER
MLC104: MATLAB for Mechanical Engineering

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

5th Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
FIFTH SEMESTER															
1	5	PC		22ME501	Heat Transfer	**T**	3	0	0	3	3	30	30	40	3
2	5	PC		22ME502	**Lab:-** Heat Transfer	**P**	0	0	2	2	1		60	40	
3	5	PC		22ME503	Fluid Machines	**T**	3	0	0	3	3	30	30	40	3
4	5	PC		22ME504	**Lab:-** Fluid Machines	**P**	0	0	2	2	1	0	60	40	
5	5	PC		22ME505	Operations Research Techniques	**T**	3	0	0	3	3	30	30	40	3
6	5	OE-I			**Open Elective - I ***	**T**	3	0	0	3	3	30	30	40	3
7	5	OE-II			**Open Elective - II ***	**T**	3	0	0	3	3	30	30	40	3
8	5	PC		22ME506	**Lab:-** Machine Drawing	**P**	0	0	2	2	1		60	40	
9	5	PC		22ME507	Mechanical measurement & Instrumentation	**T**	3	0	0	3	3	30	10	60	3
10	5	PC		22ME508	**Lab:-** Mechanical measurement & Instrumentation	**P**	0	0	2	2	1		60	40	
11	5	STR		22ME509	**Industrial training, Seminar & Report**	**P**	0	0	0	0	1		100		
					TOTAL FOURTH SEM		**18**	**0**	**8**	**26**	**23**				

Open Elective-I*

1	5	OE-I	ME	22ME531	OE I : Operations Research Techniques
2	5	OE-I	ME	22ME532	OE I : Automobile Engineering
3	5	OE-I	ME	22ME533	OE I : Control System Engineering
4	5	OE-I	ME	22ME534	OE I: Robotics and Subtractive Manufacturing

Open Elective-II*

1	5	OE-II	ME	22ME551	OE II : Total Quality Management
2	5	OE-II	ME	22ME552	OE II : Reliability Engineering
3	5	OE-II	ME	22ME553	OE II : Power Generation Engineering
4	5	OE-II	ME	22ME554	OE II : Project Evaluation & Management

List of Mandatory Learning Course (MLC)												
1	5	HS	T&P	MLC2125	YCAP5: YCCE Communication Aptitude Preparation	A	3	0	0	3	0	
2	5	HS	R&D	MLC125	Design Thinking	A	2	0	0	2	0	

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA = for Practical : MSPA will be 15 marks each**

		June 2022	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

V SEMESTER
22ME501 : Heat Transfer

Course Outcomes:
Upon successful completion of the course, the students will be able to; • **Analyse and solve** the problems of unidirectional steady-state heat conduction systems. • **Investigate and apply** the empirical correlations in convection and phase change processes **to estimate** the heat transfer coefficient. • **Design & analyze** the heat exchangers with LMTD & ϵ-NTU methods. • **Examine and evaluate** the net thermal radiation exchange between surfaces and **estimate** radiation view factors using tables, graphs, and the view factor relationships.

Unit I:	(8 Hrs.)
Introduction: Modes of Heat Transfer, Basic Laws of Heat Transfer and Conservation of Energy requirement. Derivation of general Heat conduction equation in Cartesian, Cylindrical and Spherical Co-ordinates, Thermal conductivity, and Thermal diffusivity. One dimensional steady state conduction equation for the plane wall, Cylinder and Sphere, Thermal resistance of composite structures, Contact resistance, and overall heat transfer coefficient.	
Unit II:	**(7 Hrs.)**
Conduction with uniform internal heat generation: within plane wall, solid Cylinder and solid sphere, Extended **Surfaces with uniform cross section area**, temperature distribution and their heat transfer rate, Fin efficiency and effectiveness.	
Unit III:	**(7 Hrs.)**
Forced Convection: Physical signification of related non-dimensional parameters, Newton's law of cooling, Concept of velocity and thermal boundary layer, Local and average heat transfer coefficient, Using Empirical co-relation (from heat transfer data book) for heat transfer during external and internal flow in laminar and turbulent regime for UHF and UWT condition, for determination of heat transfer coefficient.	
Unit IV:	**(7 Hrs.)**
Natural Convection: Grashoff number, Rayleigh number, Hydrodynamic and Thermal Boundary Layer. Using Empirical co-relation (from heat transfer data book) for heat transfer during external flow in laminar and turbulent regime for UHF and UWT condition (over plates & cylinders in Horizonal and vertical position, and over sphere). **Heat transfer with phase change (Theory only):** Pool boiling phenomenon, curve and regimes of pool boiling, Film and drop wise condensation, Film wise condensation on vertical surface (plate & cylinder), horizontal tube & bank of tubes, effect of superheated and non-condensable gasses on condensation heat transfer.	

Unit V:	**(8 Hrs.)**
Heat Exchanger: Classification of heat exchangers, overall heat transfer coefficient, fouling factor, temperature distribution Heat Exchanger Analysis for parallel & Counter flow heat exchangers using LMTD Approach and Effectiveness - NTU approach.	
Unit VI:	**(8 Hrs.)**
Radiation **Basic Radiation Concepts:** Fundamentals, Basic ideas, spectrum, basic definitions, radiative properties of opaque surfaces, Spectral and directional variations, emissive power, radiosity, intensity of radiation and solid angle, Band Emission. Black Body Radiation Laws: Planck's law, Stefan Boltzmann law, Wien's Displacement law, Kirchhoff's law, Lambert cosine law, **Radiation Energy Exchange:** Concept of black and gray bodies, Radiation exchange between black surfaces, Radiation exchange between gray surfaces Shape Factor Concepts– Definition, relations, and its properties. Radiation network for radiative exchange. Radiation between parallel plates, concentric Cylinders, and concentric spheres & simple enclosures.	
	Total Lecture | **45 Hours**

Textbooks:

SN	TITLE	EDITION	AUTHOR	PUBLICATION
1	Introduction to heat transfer	7th Edition(2022)	Incropera & Dewitt J. Wiley	John Wiley & Sons
2	Elements of heat transfer	Edition (2023)	M. N. Ozisik	McGraw-Hill
3	Heat transfer	7th Edition(2020)	S. P. Sukhatme	Universities press (India)
4	Heat Transfer	Edition (2022)	Yunus A Cengel	McGraw-Hill,
5	Fundamentals of Heat & Mass transfer	4th Edition (2020)	M. Thirumaleshwar	Pearson
6	"Heat and Mass Transfer Data Book"	8th Edition, 2020.	C. P. Kothandaraman and Subramanian.	New Age International Publications.
7	Fundamentals of Heat and Mass Transfer	4th Edition	C.P. Kothandaraman	New Age Publishers

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Reference Books:			
SN	Author Name	Title	Publication
1.	Holman, J. P.	"Heat Transfer",	McGraw Hill.
2.	Frank Kreith.	Principles of Heat Transfer	Harper and Row Publishers, New York.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
MOOCs Links and additional reading, learning, video material	
1	https://onlinecourses.nptel.ac.in/noc19_ch23/preview
2	https://www.classcentral.com/course/swayam-heat-transfer-10061

V SEMESTER
22ME502 : Lab. Heat Transfer

Course Outcomes
Upon successful completion of the course the students will be able to • Analyse and solve the problems of unidirectional steady state heat conduction systems. • Investigate and apply the empirical correlations in convection and phase change processes to estimate the heat transfer coefficient. • Design & analyse the heat exchangers with LMTD & ϵ-NTU methods. • Examine and evaluate the net thermal radiation exchange between surfaces and estimate radiation view factors using tables, graphs and the view factor relationships.

Minimum Eight Practical's to be performed from the list below

Sr. No.	Experiments based on CONDUCTION:
1	Determination of thermal conductivity of metal bar.
2	Determination of **thermal conductivity of insulating** material in the powder form (Lagged Pipe).
3	Determination of thermal conductance of a **composite wall**.
4	Heat Transfer through FINs.
	Experiments based on CONVECTION:
5	Determination of **forced convection heat transfer coefficient** for fluid flow through a closed conduit.
6	Determination of natural convection heat transfer coefficient for a vertical surface.
	Experiments based on HEAT EXCHANGER:
7	Determination of **effectiveness and overall heat transfer coefficient** for parallel flow and counter flow concentric tube heat exchangers.
	Experiments based on RADIATION:
8	Determination of emissivity of non-black surfaces.
9	Determination of Stefan-Boltzmann constant.
10	Study of heat pipes
11	Study of pool boiling phenomenon (Nukiyama Curve).
12	Study of condensation heat transfer in film wise & drop wise modes.

V SEMESTER
22ME503 : Fluid Machines

Course Outcomes :
Upon successful completion of the course, the students will be able to; • The student will be able to describe and analyze the working of Positive Displacement Pumps • The student will be able to describe and analyze the working Centrifugal Pumps • The student will be able to define evaluate Static and Stagnation properties and; describe and analyze the compressible flow. • The student will be able to describe and analyze the working of compressors.

Unit I: Positive displacement Pumps	**(8 Hrs.)**
Classification of Positive displacement Pumps: Study of Rotary pumps such as vane pump, Gear pump and Screw pump. Reciprocating pumps: Basic principle, types, Main components, Slip, Work done. Indicator diagrams, Separation, Air vessels	
Unit II: Centrifugal Pumps	**(7 Hrs.)**
Centrifugal Pumps: Components and Principles of operation, Classification, Priming, Fundamental equation, Various heads, Velocity triangles and their analysis, Effect of outlet blade angle, Vane shapes, Losses & efficiencies of pumps, N.P.S.H , Cavitations in pumps, Performance characteristics	
Unit III: Hydraulic Turbines	**(8 Hrs.)**
Hydraulic Turbines: Classification, Classification of water turbines, Pelton wheel, its construction and working,velocity triangles, efficiency, power, work done. Principle of operation, Construction and working of Francis and Kaplan Turbine, Effect of modification of velocity triangles on runner shape. Introduction of steam turbines and Compounding of steam turbines	
Unit IV: Reciprocating compressors	**(7 Hrs.)**
Reciprocating compressors: - Parts, Operations, Work done during isothermal, polytropic & adiabatic compression process, P-V diagram, isothermal efficiency, Effect of clearance, volumetric efficiency, Mechanical efficiency. Multistaging in reciprocating compressor, condition for minimum work input, capacity control, Actual indicator diagram]	
Unit V: Compressible Flow	**(8 Hrs.)**
Compressible Flow: Stagnation properties, speed of sound wave, Mach number, one dimensional isentropic flow, Stagnation properties, Isentropic flow through convergent-divergent nozzles, Adiabatic Expansion in Nozzles, Maximum Discharge Critical Pressure Ratio, Calculation of Throat and Exit Areas,	
Unit VI: Centrifugal compressor	**(7 Hrs.)**
Centrifugal compressor: -Principle, operation, parts, velocity diagram, static & stagnation quantities, work done by impeller, isentropic efficiency of compressor. Slip factor, pressure coefficient and power input factor. Concept of Axial Compressor	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Modi, PN, and Seth, SM, Hydraulics and Fluid Mechanics, Delhi Standard Publishers Distributors, 2015
2.	Rajput R.K, Thermal Engineering , 10th Edition, Laxmi Publications (P) Ltd, 2017

Reference Books:	
1.	Banga & Sharma, Hydraulic Machines, Khanna Publishers, 2019
2.	Nag P K, Thermal Engineering, Tata McGraw-Hill Education, 2020.
3.	Soman.K, Thermal Engineering, PHI Learning Private Ltd, 2016.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781119902973.ch4
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119902973?SeriesKey=10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112106133
2.	https://nptel.ac.in/courses/112103249

V SEMESTER
22ME504 : Lab. Fluid Machines

Course Outcomes
Upon successful completion of the course the students will be able to • The student will be able to describe and analyze the working of Positive Displacement Pumps • The student will be able to describe and analyze the working Centrifugal Pumps • The student will be able to define evaluate Hydraulic turbine • The student will be able to describe and analyze the working I.C. Engine and VCRS.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Study of Positive Displacement Rotary Pumps
2	Trial on Reciprocating Pump
3	Trial on Centrifugal Pump
4	Trial on reciprocating compressor
5	Trial on rotary Blower.
6	Trial on Pelton wheel
7.	Trial on Francis Turbine
8	Trial on Kaplan Turbine
9	Performance testing of a single cylinder I.C. Engine.
10	Trial on Petrol Engine with energy balance sheet.
11	Heat balance on Multicylinder Diesel Engine.
12	Performance on Vapor Compression Refrigeration System (VCRS).
13	Performance on air-conditioning system.

V SEMESTER
22ME505 : Operations Research Techniques

Course Outcomes:

Upon successful completion of the course the students will be able to

- Recognise the importance of Optimisation in solving practical problems in industry.
- Formulate real world decision making scenarios in to mathematical models.
- Understand Operations Research models and apply them in the field of manufacturing, finance, Project management, human resource management etc.
- Use optimisation tools to solve a mathematical model for a practical problem.

Unit:1	Linear Programming Problems:	**7 Hours**
Introduction to Linear Programming Problems: Formulation of LPP, Geometry of LPP and Graphical Solution of LPP, Simplex Method, Big M- Method, Two Phase Method **Contemporary Issues related to Topic**		
Unit:2	Transportation Problem:	**8 Hours**
Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method. Assignment Model **Contemporary Issues Related to Topic**		
Unit:3	Dynamic programming:	**8 Hours**
Dynamic programming characteristics, approach and its formulations. Application of Dynamic programming in Employment smoothening problem, Resource allocation, Inventory control & Linear programming. **Contemporary Issues related to Topic**		
Unit:4	Project Management:	**7 Hours**
Project Management: Network Scheduling by CPM & PERT, Cost considerations in PERT and CPM **Contemporary Issues related to Topic**		
Unit:5	Replacement Models:	**8 Hours**
Replacement Models: Replacement of Models that deteriorate with time, Concept of equivalence, Interest Rate and Present worth. Replacement of items that fails suddenly considering Individual and Group replacement policy. **Contemporary Issues Related to Topic**		
Unit :6	Queuing Theory and Simulation:	**7 Hours**
Queuing Theory: Queuing Systems, Kendelalls for representing queuing models, Classification of queuing models (No derivations expected), Simulations, Monte-Carlo Simulation. **Contemporary Issues Related to Topic**		
	Total Lecture Hours	**45 Hours**

Text books	
1	Taha,H.A., "An Introduction to Operations Research", 6th Ed.,Prentice Hall of India, 2001
Reference Books	
1	Hillier, F.J., Lieberman, G.J., "Introduction to Operations Research"7th Ed., Holden Day Inc., 2001
2	Gross, D., and Harris, C.M., "Fundamentals of Queuing Theory", 2nd Ed., John Wiely & sons, NY, 1985
3	Panneer selvam R., Operations Research, PHI, 2011
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

V SEMESTER

22ME531 : OE I : Operations Research Techniques

Course Outcomes:

Upon successful completion of the course the students will be able to

- Recognise the importance of Optimisation in solving practical problems in industry.
- Formulate real world decision making scenarios in to mathematical models.
- Understand Operations Research models and apply them in the field of manufacturing, finance, Project management, human resource management etc.
- Use optimisation tools to solve a mathematical model for a practical problem.

Unit:1	Linear Programming Problems:	**7 Hours**
Introduction to Linear Programming Problems: Formulation of LPP, Geometry of LPP and Graphical Solution of LPP, Simplex Method, Big M- Method, Two Phase Method **Contemporary Issues related to Topic**		
Unit:2	Transportation Problem:	**8 Hours**
Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method. Assignment Model **Contemporary Issues Related to Topic**		
Unit:3	Dynamic programming:	**8 Hours**
Dynamic programming characteristics, approach and its formulations. Application of Dynamic programming in Employment smoothening problem, Resource allocation, Inventory control & Linear programming. **Contemporary Issues related to Topic**		
Unit:4	Project Management:	**7 Hours**
Project Management: Network Scheduling by CPM & PERT, Cost considerations in PERT and CPM **Contemporary Issues related to Topic**		
Unit:5	Replacement Models:	**8 Hours**
Replacement Models: Replacement of Models that deteriorate with time, Concept of equivalence, Interest Rate and Present worth. Replacement of items that fails suddenly considering Individual and Group replacement policy. **Contemporary Issues Related to Topic**		
Unit :6	Queuing Theory and Simulation:	**7 Hours**
Queuing Theory: Queuing Systems, Kendelalls for representing queuing models, Classification of queuing models (No derivations expected), Simulations, Monte-Carlo Simulation. **Contemporary Issues Related to Topic**		
	Total Lecture Hours	**45 Hours**

Text books	
1	Taha,H.A., "An Introduction to Operations Research", 6th Ed.,Prentice Hall of India, 2001
Reference Books	
1	Hillier, F.J., Lieberman, G.J., "Introduction to Operations Research"7th Ed., Holden Day Inc., 2001
2	Gross, D., and Harris, C.M., "Fundamentals of Queuing Theory", 2nd Ed., John Wiely & sons, NY, 1985
3	Panneer selvam R., Operations Research, PHI, 2011
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

V SEMESTER
22ME532 : OE-I : Automobile Engineering

Course Outcomes:

Upon successful completion of the course the students will be able to

- analyze various systems of Engine, its function including fuel supply, cooling and lubrication system in vehicle.
- describe various power transmission systems from clutch to wheel in vehicle.
- evaluate and describe control systems like steering and brakes in vehicle.
- illustrate and describe the necessary electrical and luxurious systems and safety system in vehicle.

Unit:1	Power Plant	8 Hours

Introduction, classification, history & development of Automobiles. Vehicles layout, Various engine systems and components, construction & working of I.C. engines.

Introduction to Fuel supply system: for Petrol and Diesel Engine, CRDI, GDI, EFI, MPFI, Engine fuels: Gasoline, diesel, bio-diesel, CNG.

Engine cooling and lubrication systems.

Contemporary Issues related to Topic : Power system : electrical, hybrids, solar, wind, compressed air, fuel cell, hydrogen etc.

Unit:2	Transmission	8 Hours

Clutch: Necessity, requirements & Types of a clutch

Gear box: Classification, Necessity & working principle of gear box, Propeller shaft, Slip & Universal joints.

Differential: Need and working, Differential lock, Rear Axles and Front Axles.

Contemporary Issues related to Topic: Introduction to Automatic Transmission: Fully and Semi-automatic.

Unit:3	Steering, Suspension & Brakes	8 Hours

Steering systems: principle of steering, steering linkages, steering geometry and wheel alignment, steering gear box and its types.

Suspension systems: Function, conventional and Independent suspension System, shock absorber.

Brakes: Drum and Disc brakes, Comparison, Mechanical, hydraulic, Air brakes.

Contemporary Issues related to Topic: Power steering

Unit:4	Wheels & vehicle dynamics	7Hours

Wheel and Tyres: Construction & classification of wheels & Tyres, tyre specification, factors affecting tyre performance.

Resistance to vehicle motion: Air, Road and gradient resistance and power calculation, Low and high speed turning, tyre cornering forces, Vehicle aerodynamics and its necessity.

Contemporary Issues related to Topic: Race car aerodynamics

Unit:5	Electrical systems	7 Hours

Electrical systems: Battery construction. Specification. Operation of Batteries. Charging of battery, Alternator, Starting system, Battery Ignition and magneto ignition systems, Lighting, Horn, Side indicator, wiper, and other electrical systems, Automobile air-conditioning, Panel Board instruments.

Contemporary Issues related to Topic: Introduction to EV's

Unit :6	Maintenance & Safety	7 Hours
Engine overhauling, Engine tune up, Tyre rotation & balancing, Fault detection techniques and remedies. Collision avoidance system and vehicle to vehicle communication, Airbags system, EBD, ABS and other safety features, cruise control. **Contemporary Issues related to Topic:** Navigation system and control.		
	Total Lecture Hours	**45 Hours**

Text books	
1	Singh Kirpal, Automobile Engineering, Volume 1 & 2, Standard publishers and distributors, 14th Edition, 2021
Reference Books	
1	Ganesan V, Internal Combustion Engines, 4th Edition, McGraw Hill Education, 2012.
2	Rajpoot R K, A text book of Automobile Engineering, Laxmi publications (P) Ltd., 1st Edition, 2007.
3	Sethi H M, Automotive Technology, McGraw-Hill Education, 1991
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

V SEMESTER
22ME533 : OE-I : Control System Engineering

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Illustrate the mathematical representation of various control system and determine the transfer function of mechanical, electrical, thermal and fluid system.
- Analyse the working of various control system components of electrical motor and hydraulic system..
- Evaluate the performance of control system using time response analysis.
- Create the performance of control system on the basis of frequency response and root locus and design suitable compensation for the control system.

I	Introduction:- Introduction, System concept Open and Closed loop control systems. Transfer function, Mathematical Modelling of Physical System and system representation through Block Diagram. Transfer function through Block Diagram Simplification. Signal Flow Graph, Masons Gain Formula Block diagrams of various control systems. (CO-1)	**7 Hrs**
II	Mathematical Modelling:- Representation of Control components: Mechanical and Electrical components; Analogous systems. (CO-1)	
III	Electrical system:- Ac/dc servomotors; field controlled and armature-controlled servomotors; positional servomechanisms, Potentiometer, Synchro, stepper motors. Hydraulic systems: - Hydraulic pumps (gear; vane; and reciprocating piston) Cylinders, Direction control valves (2, 3, 4 way) Flow control valve; Relief valve Hydraulic servomotor (CO-2)	
IV	Time response analysis:- Transient and steady state response of first and second order systems Concept of stability; relative stability; Routh stability criteria. (CO-2)	
V	Bode and Polar plot:- Frequency response and its characteristics; Bode plots; Polar plots, Nyquist plots. Gain margin and phase margin. Identification of system transfer function (CO-3)	
VI	Root Locus:- Basic control actions; Proportional Integral and Derivative control actions and their effect on system performance. Root locus technique. Introduction to control system design log load compensation Feed Back Compensation and Pole -Zero placements (CO-4	
	Total Lecture	45 Hours

Text books	
1	Modern Control Engineering 3rd Edition (2009) Ogata Prentice Hall
2	Control system Engineering 4th Edition (2007) Nise John Wiley & Sons
Reference Books	
1	Control system 4th Edition (2009) Nagrath & Gopal New Age International
2	Modern Control System 12th Edition (2009) Dorf Pearson
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

V SEMESTER

22ME534 : OE-I : Robotics and Subtractive Manufacturing

Course Outcomes:
Upon successful completion of the course, the students will be able to • Understand workings of subtractive manufacturing • Implement CNC programs for various product manufacturing • have knowledge of Robotics, automation, robotics motion, sensors, robotic programming and roles of robots in the industry • Understand the working methodology of robotics and automation, motion and control, machine vision and programming, and application of robots in industry.

Unit:1	**8 Hours**
Concepts of NC, CNC, DNC. Classification of CNC machines, MCU architecture and functionality, Machine Configurations, Types of control, CNC controller's architecture and characteristics, Interpolators.	
Unit:2	**7 Hours**
Positioning system, Cutter offset compensation, Word address format, Introduction to G and M codes Manual part programming for CNC turning, milling and drilling.	
Unit:3	**8 Hours**
Tooling system for Machining center and Turning center, work holding devices, of CNC Machines. APT part programming, CAD/CAM programming, Simulation and Verification of CNC programs, Adaptive CNC control techniques. Integration of CNC machines for CIM.	
Unit:4	**7 Hours**
Robot – Definition – Robot anatomy – Co-ordinate systems, work envelope, types and classification – Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions – Need for robots – Different applications.	
Unit:5	**8Hours**
Forward kinematics – Inverse kinematics – Differences: Forward kinematics and Reverse kinematics of manipulators with two and three degrees of freedom (In 2 dimensional), four degrees of freedom (In 3 dimensional) – Deviations and problems ,Introduction to DH notations	
Unit :6	**7 Hours**
ROBOT PROGRAMMING Teach pendant programming – Lead through programming – Robot programming languages – VAL programming – Motion commands – Sensor commands – End effecter commands – Simple programs. **IMPLEMENTATION** Implementation of robots in industries – Various steps - Safety considerations for robot operations.	
Total Lecture Hours	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Text books	
1	Robot Engineering An Intergrated approach 2004 Klafter R.D., Chmielewski T.A. and Negin M Springer
2	Industrial Robotics: Technology, Programming and Applications, 2012 Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta 2nd Edition, Tata McGraw Hill, 2012.
3	Automation in Production system 2002 Mikell P. Groover Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
Reference Books	
1	CNC Technology and Programming 2003 Krar, S., and Gill Industrial Press Inc
2	An Introduction to CNC Machining 1991 Gibbs, D. Industrial Press
3	Computer Numerical Control Concepts and Programming 1991 Seames, W.S. Thomson Learning EMEA, Limited
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

V SEMESTER

22ME551 : OE-II : Total Quality Management

Course Outcomes :
Upon successful completion of the course, the students will be able to 1. Develop an understanding on quality management philosophies and frameworks. 2. Develop in-depth knowledge on various tools and techniques of quality management. 3. Evaluate the applications of quality tools and techniques in both manufacturing and service industry 4. Analyze quality management methods and solving problems of organization

Unit:1		**7 Hours**
Principles of Quality Management, Pioneers of TQM, Quality costs, Quality system Customer Orientation, Benchmarking, Re-engineering		
Unit:2		**7 Hours**
Leadership, Organizational Structure, Team Building, Information Systems and Documentation – Quality Auditing, ISO 9000 - QS 9000.QMS, Quality awards.		
Unit:3		**8 Hours**
Single Vendor Concept, J.I.T., Quality Function deployment, Quality Circles, KAIZEN, SGA POKA -YOKE, Taguchi Methods. SMED, Kanban system. Cost of quality. Robust design		
Unit:4		**7 Hours**
Methods and Philosophy of Statistical Process Control, Control Charts for Variables and Attributes		
Unit:5		**8 Hours**
Cumulative sum and exponentially weighted moving average control charts, Others SPC Techniques – Process Capability Analysis. Acceptance Sampling Problem, Single Sampling Plans for attributes, double, multiple and sequential sampling,		
Unit :6		**8 Hours**
Six sigma manufacturing concepts. Six-sigma philosophy Quality strategy and policy. Motivation and leadership theories. Continuous vs. breakthrough improvements. Management of change, DMAIC Methodology. Lean manufacturing		
	Total Lecture	**45 Hours**

Text Books	
1	Total Quality Management for Engineers 1991 Mohamed Zairi Woodhead Publishing Limited 1991
2	Production and Operations management - Total Quality and Responsiveness 1995 Harvid Noori and Russel McGraw-Hill Inc, 1995 3rd Edition
3	Managing for Total Quality 1998 N.Logothetis Prentice Hall of India Pvt .Ltd,1998
Reference Books	
1	The Essence of Total Quality Management 1995 John Bank Prentice Hall of India Pvt. Ltd., 1995.
2	Introduction to Statistical Quality Control 1991 Douglus C. Montgomery2nd Edition, John Wiley and Sons, 1991.
3	Statistical Quality Control 1984 Grant E.L and Leavensworth McGraw-Hill, 1984.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	

V SEMESTER
22ME552 : OE-II : Reliability Engineering

Course Outcomes :
Students will be able to: 1. Interpret Reliability, Maintainability, and Availability of engineering systems. 2. Apply Reliability Modeling as a tool for evaluating system performance. 3. Analyze the failure of a machine and the failure rate of systems or components 4. Create production & maintenance schedules of particular engineering systems using various tools used for failure data analysis.

Unit I: Fundamental concepts	**(8 Hrs.)**
Reliability definitions, failure, Failure density, Failure Rate, Hazard Rate, Mean Time To Failure, MTBF, maintainability, availability, safety and reliability, Quality, cost and system effectiveness, Life characteristic phases, modes of failure, Quality and reliability assurance rules, product liability, Importance of Reliability,	
Unit II: Probability theory:-	**(7 Hrs.)**
Set theory, laws of probability, total probability theorem, probability distributions, parameters and applications.	
Unit III: System reliability and modelling:	**(7 Hrs.)**
Series and parallel components, mixed configuration, complex systems. Redundancy, element redundancy, unit redundancy, standby redundancy. Types of standby redundancy, parallel components. Markov models for reliability estimation.	
Unit IV: Maintainability and Availability:	**(8 Hrs.)**
Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system downtime. Availability - Inherent, Achieved, and Operational availability, reliability, and maintainability trade-off. Markov models for availability estimation.	
Unit V: System Reliability Analysis:	**(7 Hrs.)**
Reliability allocation or apportionment. Reliability apportionment techniques. Reliability block diagrams and models. Reliability predictions. Life testing and accelerated testing.	
Unit VI: Strength-based reliability:	**(8Hrs.)**
Safety factor, safety margin, Stress strength interaction, Failure Mode, Effects and Criticality Analysis-, , FMECA examples, Ishikawa diagram .fault tree construction, basic symbols development of functional reliability block diagram, Fault tree analysis, fault tree evaluation techniques, Design of Mechanical components and systems:-Material strengths and loads.	
Total Lecture	**45 Hours**

Text Books	
1	Concepts of Reliability Engg 1985 L.S. Srinath Affiliated East-Wast Press (P) Ltd
2	Reliability Engineering 1983 A.K. Govil Tata McGraw-Hill Publishing Co. Ltd
3	Reliability Engineering 1984 E. Balagurusmy Tata McGraw-Hill Publishing Co. Ltd
Reference Books	
1	Engineering Reliability 1980 B.S. Dhillion, C. Singh John Wiley & Sons
2	Probabilistic, Reliability 1968 M.L. Shooman McGraw-Hill Book Co.,
3	Reliability in Engineering Design 1977 K.C. Kapur, L.R. Lamberson John-Wiley and sons.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	

V SEMESTER
22ME553 : OE-II : Power Generation Engineering

Course Outcomes:
Students will be able to: 1. Analyze and compare the various Thermal power plants. 2. Analyze the hydroelectric and nuclear power plant 3. Evaluate and compare the economics of various power plants. 4. Interpret the non-conventional and combined operations of different power plants.

Unit:1 THERMAL POWER PLANT- I	**8 Hours**
Introduction to thermal power plants and power plant layouts. Site selection. Fuel characteristics, handling, storage, preparation & firing methods. Ash & dust collection and handling. • Boiler: classification, general arrangement, details of different components and system like draught system, steam turbine systems, condenser, cooling towers	
Unit:2 THERMAL POWER PLANT- II	**7 Hours**
Gas Turbine Power Plant: -Introduction, power plant layouts, Open cycle, close cycle power plants. Various components and systems. Methods to improve efficiency. Reheat and Regeneration cycle and their combinations Diesel Electric Power Plant: - Introduction, Outline, type of engines, different components, performance, plant layout. Comparison with other power plant. (visit to nearby power plant shall be arrange for the students)	
Unit:3 HYDROELECTRIC POWER PLANT.	**8 Hours**
Hydrology: - Rainfall, Runoff, Hydro graph, flow duration curve, mass curve. Hydroelectric power plant: - Site selection, classification of hydroelectric power plant, general arrangement, details of different components, turbine selection. Governing. • Comparison with other power plant.	
Unit:4 POWER PLANT ECONOMICS	**7 Hours**
Load Analysis - Fluctuating Load on power plants, Load curves, various terms & definition, peak load, effect of fluctuating load. • Economic Analysis: - Cost of electric energy	
Unit:5 NUCLEAR POWER PLANT	**8Hours**
ion to Nuclear Engineering, Global scenario, prominent installations worldwide, present & proposed nuclear plant in India. Nuclear Reactors: - Types of reactors, PWR, BWR, CANDU, Gas cooled, liquid metal cooled, Breeder reactor. Operational requirements and difficulties, site selection for location of a nuclear power station Nuclear Waste Disposal. • Comparison with other power plant.	
Unit :6 COMBINED OPERATION OF DIFFERENT POWER PLANTS	**7 Hours**
Combined operation: - Need division, combination of different plant & their coordination, advantages. **NON-CONVENTIONAL POWER GENERATION SYSTEMS** Introduction to Non-Conventional power Generation Systems • Geo-Thermal Power Plant, Tidal Power Plant, Wind Power Plant, Solar Power Plant.	
Total Lecture Hours	**45 Hours**

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Text books	
1	"Power Plant Engineering" by A.K. Raja, Amit Prakash Srivastava, and Manish Dwivedi, published in its 1st edition by New Age International Publisher
2	"Power Plant Engineering" by Frederick T. Morse, now in its 3rd edition and published by Van Nostrand Reinhold
3	"Power Plant Engineering" by P.K. Nag, which is currently in its 4th edition and published by McGraw Hill Education
Reference Books	
1	Power Plant Engineering Larry Drbal, Kayla Westra, and Pat Boston 1st Edition Springer
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

V SEMESTER

22ME554 : OE-II : Project Evaluation & Management

Course Outcomes:
Upon successful completion of the course the students will be able to 1. Examine and screen project ideas. 2. Analyze the Technical and Economical feasibility of the project. 3. Design and analyze the project and prepare project report 4. Evaluate the project on Economical, Social and Environmental aspects.

Unit:1	**Project Identification**	**7 Hours**
Project identification considering objectives - B2B, B2C and SWOT analysis, Screening of Project Ideas, Technical, Market, Financial, Socioeconomic and Ecological Appraisal of a project, demand forecasting, secondary data, accuracy, confidence level, uncertainty. **Contemporary Issues related to Topic**		
Unit:2	**Technical feasibility**	**7 Hours**
Technical feasibility- Process selection, Level of automation, Plant capacity, Acquiring technology, Appropriate technology Plant location, Skill requirement & availability of Manpower- Both white collar & Blue collar, Equipment selection & procurement, Govt. policies, Value analysis and project evaluation. **Contemporary Issues related to Topic**		
Unit:3	**Economic feasibility**	**9 Hours**
Economic feasibility- Cost of Project, working capital analysis, fixed cost, means of finance, estimation of sales & production, price analysis, Break-even point, Projected cash flow statements, projected balance sheet, projected profit & loss statement, projected cash flow, rate of return, Discounted payback period, cost benefit analysis, return after taxes. **Contemporary Issues related to Topic**		
Unit:4	**Project Planning and Control**	**7 Hours**
Project Planning and Contro-: Work break down structure and network development, Basic Scheduling, Critical Path and four kinds of floats, Scheduling under probabilistic durations, Time Cost tradeoffs, CPM, PERT, Optimum project duration, resource allocation, updating. **Contemporary Issues related to Topic**		
Unit:5	**Project report**	**7 Hours**
Project report- Preparation of project report, Project safety management, risk analysis, sensitivity analysis, methods of raising capital **Contemporary Issues related to Topic**		

			July 2022	1.00	Applicable for AY 2022-23 Onwards
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Unit:6	Project review	8 Hours
Initial review, pre commissioning safety review, performance analysis, ratio analysis, sickness, project revival, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion environmental & social aspects. **Contemporary Issues related to Topic**		
	Total Lecture Hours	**45 Hours**

Text books	
1	Prasanna Chandra, Projects, 9th Edition, McGraw Hill Education (India) Private Limited, 2019
Reference Books	
1	L. S. Srinath, PERT and CPM-Principles and Application, 3rd Edition, East West publisher, 2001
2	M. Y. Khan and P. K. Jain, Financial Management, Tata McGraw Hill Education Private Limited, 6th edition, 2011
3	R. Panneerselvam, Engineering Economics, PHI Learning Private Limited, New Delhi,2nd edition, 2014
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/110107081
2	https://nptel.ac.in/courses/110104073

V SEMESTER
22ME506 : Lab:- Machine Drawing

Course Outcomes :
Upon successful completion of the course the students will be able to • Understand and apply the detail drawing of a given object. • Interpret and prepare the drawing. • Construct details and assembly different mechanical systems. • Create an assembly drawing into detailed drawing using modeling software.

Unit I: Drawing Standards for following	**(8 Hrs.)**
Drawing Standards for following - Drawing Sheets, Name Blocks, Lines, Sections, Dimensioning, Dimensioning of Tolerances, Standard Components, Standard features, Machining Symbols, Welding Symbols, Heat Treatment, Manufacturing Instructions, Allowances, Materials. (CO1)	
Unit II: Orthographic Projection of Elements	**(6 Hrs.)**
Orthographic Projections, Sectional Views, Missing Views, Profiles, Cross-Sections, References, Alignments, Dimensioning. (CO2)	
Unit III: Study Qualitative Selection of type / Size (Excluding Design Calculations) and Standard Practices for Following Elements	**6 Hrs.)**
Threads, Bolts, Nuts, Washers, Rivets, Welds, Keys and Keyways, splines, Couplings. (CO2)	
Unit IV: Assembly and Dismantling Principles	(8Hrs.)
Fits and Tolerances (Standards, Types Application, and Selection), Tolerance Charting, Surfaces Finishing Requirement for Assembly, Geometry suitable for Assembly, Assembly / Dismantling Tools, Bearing Assemblies, Assemblies by Fastening. (CO3,4)	
Unit V: Study of some Standard Assemblies.	**(9 Hrs.)**
Assembly Drawings: Principles, Techniques, and standards for Preparing Component Drawings, Subassembly Drawing, Full Assembly Drawing, Exploded Views. (CO3,4)	
Unit VI: Production Drawing:	**(8 Hrs.)**
Name Plates, Part List, Revisions Etc., Essential Parts/ Formats Required for Production Drawings, Process Sheet. (CO4)	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	David Allan Low., An Introduction to Machine Drawing and Design, Fourth Edition, Whitworth Scholar
2	K.L.Narayana,P,Kannaiah,Machine Drawing, Third Edition, New Age International Publishers,2006
3.	R K Dhawan., Machine Drawing , S Chand, 2022

Reference Books:	
1.	PSG Data Boo
2.	N Sidheswar, P Kannaiah, V V S Sastry, Machine Drawing
2.	CMTI Data Boo
3.	Relevant IS Codes
4.	Sidheswar sastry., Machine Drawing, TMH., New Delhi, 2014
5.	Laxmi Narayana and Mathur , Machine Drawing, M/s. Jain Brothers, New Delhi.
6	Bhatt, N. D ,Machine Drawing. ,Anand: Charotar Publishing House, 2005 7 621.7

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(G%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(E%20Series).pdf
3	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(G%20Series).pdf

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=ptJfomL1I7o&list=PLLvBXFAV-DeIsmVkmcNv2RzwCuT1XvhTV
2.	https://www.youtube.com/watch?v=cEz3jSkQ4tQ&list=PLLvBXFAV-DeIsmVkmcNv2RzwCuT1XvhTV&index=3
3.	https://www.youtube.com/watch?v=UW6iERL-EDs&list=PLLvBXFAV-DeIsmVkmcNv2RzwCuT1XvhTV&index=12
4.	https://www.youtube.com/watch?v=9fhMInOnCGE

V SEMESTER
22ME507 : Mechanical measurement & Instrumentation

Course Outcomes:

Upon successful completion of the course the students will be able to

Course Outcome	*Statement*
CO 1	Demonstrate the basic knowledge of measuring Instruments and evaluate various characteristics.
CO 2	Select proper measuring instruments and use it for measuring various parameters
CO 3	Demonstrate the basic knowledge of limits-fit, Tolerance and design of limit gauges & tolerance charts.
CO 4	Evaluate statistical process control and acceptancesampling procedures in a manufacturing environment to improve quality of process.

Unit:1		**8 Hours**
Purpose, Structure, and elements of a general measurement system. Static characteristics of measurement system, measurement error, Type of inputs, methods of corrections. Dynamic characteristics of measurements system,, Standard input signals.		
Unit:2		**7 Hours**
Study of instruments for measurements of linear & angular displacement, Types of CMM and its application		
Unit:3		**7 Hours**
Study of instruments for measurements of speed, acceleration.		
Unit:4		**7 Hours**
Study of instruments for measurements of Strain, force, and torque.		
Unit:5		**8 Hours**
Study of instruments for measurement of pressure and flow.		
Unit :6		**8 Hours**
Study of instruments for measurement of temperature, level, pressure and flow.		
	Total Lecture Hours	**45 Hours**

Text books				
1	Text book of Engineering Metrology	17th Edition (2009)	R. K. Jain	Khanna Publications,Delhi
2	Statistical Quality control	Edition (2010)	Mahajan	Dhanpai Rai & Sons, New Delhi
3	Production Engineering	Edition (2007)	P.C. "Sharma	S.Chand &CompanyLtd
4	Total quality control	3rd Edition	A.V.Feigenbaum	McGraw-Hill,
5	Mechanical Measurement And Instrumentation	2006	R. K. RAJPUT	Kataria and sons
6	Mechanical Measurement And control	5th Edition (2012)	DR D S KUMAR	Metropolitan co pvt ltd
Reference Books				
1	Engineering Metrology	15th Edition (2003)	I.C. Gupta	Dhapat Rai Publications,Delhi
2	Statistical Quality control	3rd Edition (1988)	E.L.Grant	McGraw-Hill,
3	Quality control and applications	1993	Bertrand L. Hassan,Ghare	Prentice hall of india
4	Statistical quality control	Edition (2010)	Mahajan M	Dhanpai Rai & Sons, New Delhi
5	Metrology for Engineers	Edition (1990)	John Frederick Wise Galyer, Charles Reginald Shotbolt	Cassell,
6	Mechanical measurements-Applications and Deign	6th edition 2006	Doebelin	McGraw-Hill,
7	Principles of measurements system	4th Edition (2005)	John P. Bentley	Pearson Education

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/112104118
2	https://nptel.ac.in/courses/105103192

V SEMESTER

22ME508 : Lab:- Mechanical measurement & Instrumentation

Course Outcomes:	
Course Outcome	***Statement***
CO 1	Demonstrate the basic knowledge of measuring Instruments and evaluate various characteristics.
CO 2	Select proper measuring instruments and use it for measuring various parameters
CO 3	Demonstrate the basic knowledge of limits-fit, Tolerance, and design of limit gauges & tolerance charts.
CO 4	Evaluate statistical process control and acceptance sampling procedures in a manufacturing environment to improve quality of process.

Sr. No.	**Experiments based on**
1	Calibration of Bourdon pressure gauge.
2	Speed Measurement by using Stroboscope.
3	Speed Measurement by using .Magnetic Pick Up and Photo-electric Pick Up.
4	Calibration of Thermocouple.
5	Calibration of RTD.
6	Calibration of LVDT
7	Liquid level measurement
8	To find half taper angle of a w/p using sine bar
9	To find various parameters of screw thread using TMM.
10	To find effective diameter of a threaded plug by two wire method using floating carriage machine.
11	Measurement of flatness of surface using optical flat and monochromatic light
12	To measure the surface roughness of a given w/p using Stylus probe.
13	To measure the profile of given w/p using optical profile projector
14	Design of Go and NO GO limit gauge for a given fit
15	Preparation of process planning sheet and tolerance chart.
16	To construct a control chart for a quality characteristic

V SEMESTER

22ME509 : Industrial training, Seminar & Report

Audit Course
V SEMESTER
MLC2125:

Audit Course
IV SEMESTER
MLC125 : Design thinking

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

6th Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. 22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
SIXTH SEMESTER															
1	6	PC	ME/ME	22ME601	CAD/CAM	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	6	PC	ME/ME	22ME602	CAD/CAM LAB	**P**	0	0	2	2	1		60	40	
5	6	PC	ME/ME	22ME603	Design of Mechanical Drives	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	6	PE	ME/ME		**Professional Elective -I**	**T**	3	0	0	3	3	30	20	50	3 Hrs
4	6	PE	ME/ME		**Professional Elective -I LAB**	**P**	0	0	2	2	1		60	40	
6	6	PE	ME/ME		**Professional Elective II**	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	6	PE	ME/ME		**Professional Elective III**	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	6	OE-III	ME/ME		**Open Elective - III ****	**T**	3	0	0	3	3	30	20	50	3 Hrs
9	6	OE-IV	ME/ME		**Open Elective - IV ****	**T**	3	0	0	3	3	30	20	50	3 Hrs
10	6	PR	ME/ME	22ME604	PROJECT PHASE-1	**P**	0	0	2	2	1		60	40	
					TOTAL SIXTH SEM		**21**	**0**	**6**	**27**	**24**				

List of Professional Electives- I, II & III

Professional Electives-I

1	6	PE-I	ME	22ME611	PE I : Finite Element Methods
2	6	PE-I	ME	22ME612	PE I : **Lab:-** Finite Element Methods
3	6	PE-I	ME	22ME613	PE I :Industrial Fluid Power
4	6	PE-I	ME	22ME614	PE I : **Lab:-** Industrial Fluid Power
5	6	PE-I	ME	22ME615	PE I : I.C. Engines
6	6	PE-I	ME	22ME616	PE I : **Lab:-** I.C. Engines
7	6	PE-I	ME	22ME617	PE I : Advance Welding Techniques
8	6	PE-I	ME	22ME618	PE I : **Lab:** Advance Welding Techniques
9	6	PE-I	ME	22ME619	PE I : Computer Integrated Manufacturing
10	6	PE-I	ME	22ME620	PE I : **Lab:-** Computer Integrated Manufacturing
11	6	PE-I	ME	22ME621	PE I : Mechatronics
12	6	PE-I	ME	22ME622	PE I : **Lab:-** Mechatronics
13	6	PE-I	ME	22ME623	PE I :Computer Graphics and Solid Modelling
14	6	PE-I	ME	22ME624	PE I : **Lab:-** Computer Graphics and Solid Modelling
15	6	PE-I	ME	22ME625	PE I :Two Wheeler technology
16	6	PE-I	ME	22ME626	PE I : **Lab:-** Two Wheeler technology

Professional Electives-II

1	6	PE-II	ME	22ME631	PE II : Tool Design
2	6	PE-II	ME	22ME632	PE II : Additive Manufacturing
3	6	PE-II	ME	22ME633	PE II : Fuel Cell Technology
4	6	PE-II	ME	22ME634	PE II : Material Handling Systems
5	6	PE-II	ME	22ME635	PE II : Reliability Engineering
6	6	PE-II	ME	22ME636	PE II : Bio- Mechanics
7	6	PE-II	ME	22ME637	PE II :Composites
8	6	PE-II	ME	22ME638	PE II : Data Analytics In Mechanical Engineering
9	6	PE-II	ME	22ME639	PE II : Advanced Manufacturing Techniques

Professional Electives-III

1	6	PE-III	ME	22ME651	PE III : Artificial Intelligence
2	6	PE-III	ME	22ME652	PE III : Design for Manufacturing & Assembly
3	6	PE-III	ME	22ME653	PE III : Renewable Energy System
4	6	PE-III	ME	22ME654	PE III : Plastics and Composite
5	6	PE-III	ME	22ME655	PE III : Tribology in Manufacturing
6	6	PE-III	ME	22ME656	PE III : Finance & Cost Management
7	6	PE-III	ME	22ME657	PE III : Maintenance Management

Open Electives-III**

1	6	OE-III	ME	22ME671	OE III : Operations Research Techniques
2	6	OE-III	ME	22ME672	OE III : Automobile Engineering
3	6	OE-III	ME	22ME673	OE III : Robotics and Subtractive Manufacturing
4	6	OE-III	ME	22ME674	OE III : Control System Engineering

Open Electives-IV**

1	6	OE-IV	ME	22ME691	OE IV : Total Quality Management
2	6	OE-IV	ME	22ME692	OE IV : Reliability Engineering
3	6	OE-IV	ME	22ME693	OE IV : Power Generation Engineering
4	6	OE-IV	ME	22ME694	OE IV : Project Evaluation & Management

List of Mandatory Learning Course (MLC)

1	6	HS		MLC126	**YCAP6 :**		**A**	3	0	0	3	0	

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA = for Practical : MSPA will be 15 marks each**

		June 2022	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

VI SEMESTER
22ME601 : CAD/CAM

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. Distinguish the various CAD CAM tools and also evaluate criteria for CAD-CAM systems 2. Design 2D and 3D Transformation matrices 3. Calculate and analyze the parametric equations for the wireframe. surface and solid modeling entities 4. Design the applications of modeling and evaluate data exchange formats

Unit I: CAD TOOLS	**7 Hrs.**
Definition of CAD Tools, Types of system, CAD/CAM system evaluation Criteria, functional areas of CAD, Modelling and viewing, and efficient use of CAD software.	
Unit II: Two/Three-Dimensional Transformations	**7Hrs.**
Two & Three dimensional geometric and coordinate transformations like scaling, translation, rotation, reflection, and shear. Concept of homogeneous representation and concatenated transformations. Inverse transformations.	
Unit III: Wire Frame Modelling	**7Hrs.**
Types of mathematical representation of curves, wireframe models, wireframe entities, parametric representation of analytical and synthetic curves- Hermit cubic splines, Bezier curves, B Splines	
Unit IV: Surface Modelling	**8 Hrs.**
Mathematical representation of surfaces, Surface model, Surface entities, surface representation, parametric representation of surfaces, plane surface, ruled surface, surface revolution, Tabulated surface.	
Unit V: Solid Modeling & Data Exchange	**8 Hrs.**
Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Evaluation of data-exchange formats, IGES data representations and structure	
Unit VI: Manufacturing	**8 Hrs.**
Introduction to NC and CNC, Machine tools- Construction features with structure- Drives and CNC controllers. Manual part programming (Lathe & Milling machines) Introduction of CAM package. Group Technology, Cellular Manufacturing-Composite part concept-Types of Flexibility – FMS – FMS Components, Application and Benefits.	
Total	**45 Hrs.**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
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Textbooks:	
1.	CAD/CAM, theory & practice: Ibrahim Zeid
2.	Procedural elements for computer graphics: D Rogers

Reference Books:	
	1 Computer Graphics: D Hearn & M.P.Baker 2 Computer Graphics: S Harrington. 3 Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008. 4 Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112103019/
2.	https://nptel.ac.in/syllabus/112106075/

VI SEMESTER
22ME602 : Lab. CAD/CAM

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. Distinguish the various CAD CAM tools and also evaluate criteria for CAD-CAM systems 2. Design 2D and 3D Transformation matrices 3. Calculate and analyze the parametric equations for the wireframe. surface and solid modeling entities 4. Design the applications of modeling and evaluate data exchange formats

Minimum Ten Practical's to be performed from the list below

SN	**Experiments based on**
	Exp1 Development of programs and matrix for 2D transformations. Exp 2. Introduction to CAD software (SolidWorks 2016). Exp 3. Sketching: Dimensioning and Constraining Exp. 4. Creation of Solid Model (Extrude, Cut, Revolve). Exp. 5. Creation of Special Features (Hole, Rib). Exp. 6. Creation of Special Features (Chamfer, Fillet). Exp. 7. Modification of Solid Model (Mirror). Exp. 8. Modification of Solid Model (Array). Exp. 9. Advanced Solid Model (Sweep). Exp. 10. Advanced Solid Model (Loft). Exp. 11. Assembly of part model

VI SEMESTER
22ME603 : Design of Mechanical Drives

VI SEMESTER
22ME611 : PE I : Finite Element Methods

Course Outcomes :

Upon successful completion of the course, the students will be able to;

1. **Illustrate**the stresses, strains and deformation in simple machine elements
2. **Distinguish** the fundamentals of Finite Elements Method.
3. **Analyze** the stresses, strains and deformation in simple machine elements and solutions for simple problems.
4. **Evaluate** the solutions using the CAE software for simple machine elements.

Unit I: Stress and Strain	**(8 Hrs.)**
Fundamentals of stress & strain, stress & strain components, stress strain relationship, Elastic constants, plane stress, plane strain., differential equation of equilibrium, compatibility equations, boundary conditions, Saint Venant's principle	
Unit II: Fundamental concepts of FEM	**(7 Hrs.)**
Historical background, Scope of FEM in Engineering. Applications, Principle of minimum potential energy (PMPE). FEM analysis procedure. Mathematical understanding required for FEM, Matrix algebra & operations. Methods for solution of simultaneous equations like Gauss elimination. Matrix decomposition method. Concept of Discretization of body into elements. Types of elements(2-D & 3-D elements), displacement models, convergence requirements, and shape function. Programming for above matrices	
Unit III: FEM of 1-D Element	**(8 Hrs.)**
One dimensional problems by Finite element modeling and analysis: Finite element modeling & analysis using Bar & Beam element -stiffness matrix, assembly, boundary conditions, load vector, temperature effects., Numerical on elements connected in parallel, Numerical on self-weight, numerical on Torque, numerical on Thermal stress	
Unit IV: FEM of 2-D Element	**(7 Hrs.)**
Two dimensional problems using Truss, Constant Strain Triangle& Linear Strain Triangle. FEM modeling and analysis of Truss elements, CST & LST elements, elemental stiffness matrix, assembly, boundary conditions, load vector. Stress calculation. Temperature effect. Axi-symmetric solids subjected to axi-symmetric loading -axi-symmetric formulation using CST ring, element, stiffness matrix, boundary conditions, load vector, calculation of stresses. Programming for simple 2-D problems using CST and LST elements.	
Unit V: Isoperimetric & Higher order elements	**(8 Hrs.)**
Introduction to Isoperimetric & Higher order elements. Introduction to Numerical Integration. Introduction to dynamic analysis, formulation of mass matrix for one-dimensional bar element, free vibration analysis using one-dimensional bar element.Torsion of prismatic bars using triangular elements. 3 D Element	

Unit VI: commercial software for simple machine elements	(7 Hrs.)
Application of commercial software for simple machine elements and interpretation of results.	
Total Lecture	**45 Hours**

Textbooks:	
1.	J. N. REDDY, An Introduction toThe Finite Element Method, McGraw-Hill, New York, 2005
2.	Y. M. Desai, Finite Element Method with Applications in Engineering, Dorling Kindersley, 2011
3.	Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 2002

Reference Books:	
1.	G.R. Liu, S. S. Quek, Finite Element MethodA Practical Course, Elsevier Science, 2003
2.	Kent L. Lawrence , ANSYS Workbench Tutorial Release 14, Schroff Development Corporation, 2012

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94
2.	https://www.youtube.com/watch?v=KR74TQesUoQ&list=PLbMVogVj5nJRjnZA9oryBmDdUNe7lbnB0
3.	https://onlinecourses.nptel.ac.in/noc22_me43

VI SEMESTER
22ME612 : PE I : Lab:- Finite Element Methods

Course Outcomes
Upon successful completion of the course the students will be able to 1. Study, analyse and develop the fundamentals of Finite Elements Method for mechanical engineering problems. 2. Evaluate the stresses, strains and deformation in simple machine elements and design solutions for simple problems. 3. Build the solutions using the commercial softwares for simple machine elements.

Practicals to be performed from the list below

SN	Experiments based on
1	To study about Finite Element Methods
2	To determine stress and strain in 1-D bar element by ANSYS APDL
3	To determine stress and strain in Composite element by ANSYS APDL
4	To determine principle stress and strain in CST element by ANSYS APDL
5	To determine stress and strain in CST element by ANSYS APDL
6	To study the performance of structural tutorial by ANSYS APDL
7	Deflection of Beam (Simply Supported Beam) by ANSYS APDL
8	Tutorial of 2D truss analysis in Mechanical APDL (Ansys).

VI SEMESTER
22ME613 : PE I :Industrial Fluid Power

Course Outcomes :

Upon successful completion of the course, the students will be able to;

1. To apply the fluid power laws and principals for analysis of simple fluid power systems and fluids.
2. To identify, analyse, and justify selection of suitable components of fluid power system for specific applications based on its function, performance and working characteristics.
3. To design and examine the fluid power system and to compose and interpret its circuit diagrams using standard symbols.
4. To examine the safety measures, maintenance and troubleshooting for fluid power systems.

Unit I: **(5 Hrs.)**

Fluid power systems: Components, advantages, applications in the field of M/c tools, material handling, hydraulic presses, mobile & stationary machines, clamping & indexing devices etc.
Transmission of power at static & dynamic states. Pascal's law and its application to hydraulics, Bernoulli's principle , continuity equation, analysis of simple hydraulic jack.
Types of **Hydraulic fluid**, petroleum based, synthetic & water based. Properties of fluids. Selection of fluids, additives, effect of temperature & pressure on hydraulic fluids, SAE grades and ISO viscosity numbers.
Filters, strainers, types and sources of contamination of fluid & its control, effects, ISO contaminant code.
JIC **symbols**/ISO Symbols for hydraulic & pneumatic circuits.
Hydraulic Reservoirs and Power Pack : functions and its elements, standard designs.

Unit II: **(6 Hrs.)**

Pumps: Types, classification, principle of working & constructional details of pumps used in Hydraulic system such as vane pump, gear pumps, radial & axial plunger pumps, power and efficiency calculations, characteristic Curves, selection of pumps for hydraulic power transmission.
Accumulators & Intensifiers: Types & functions of accumulators & intensifiers, applications, selection & design procedure.

Unit III: **(5 Hrs.)**

Control Of Fluid Power:
Necessity of pressure control, directional control and flow control valves, methods of actuation of valves.
Pressure Control Valves: Principle of pressure control valves, types, constructional features, direct operated, pilot operated, relief valves, pressure reducing valve, sequence valve.
Flow Control Valves: Principle of operation, types, constructional features, pressure compensated, temperature Compensated flow control valves, meter in & meter out flow control circuits, bleed off circuits.
Direction Control Valves: constructional features , types, Check valves, types of D.C. valves:- Two way two position, four way three position, four way two position valves, open center, close center,

tandem center valves, method of actuation of valves, manually operated, solenoid operated, pilot operated etc	
Unit IV:	**(5 Hrs.)**
Actuators: Classification, constructional features and working, Linear & Rotary actuators. **Hydraulic motors:** Types, vane, gear piston, radial piston. Theoretical torque, power & flow rate hydraulic motor performance. **Hydraulic Cylinders:** Types of cylinder & mountings, cushioning, calculations of force, velocity and power from a cylinder. Design consideration for cylinders.	
Unit V:	**(6 Hrs.)**
Design and analysis of Hydraulic Circuit such as: 1) Control of single and Double -acting hydraulic cylinder, 2) regenerative circuit, 3) pump unloading circuit, 4) double pump hydraulic system, 5) counterbalance valve application, 6) hydraulic cylinder sequencing circuits, 7) cylinder synchronizing circuit using different methods, 8) hydraulic circuit for force multiplication. 9) speed control of hydraulic cylinder metering in, metering out and bleed off circuits. 10) Pilot pressure operated circuits. 11) Hydraulic circuit examples with accumulator /intensifier. 12) circuit to lift and hold heavy load, 13) Pressure control for cylinders, 14) Flow divider circuits **Safety precautions, maintenance and troubleshooting of Hydraulic Circuits.**	
Unit VI:	**(6 Hrs.)**
Pneumatics: Introduction to pneumatic power sources, Characteristics of compressed air, air compressors used and Components of pneumatic system. **Air preparation units**, filters, regulators & lubricators, and silencer. compressed air distribution system in a plant; **Actuators,** linear, single & double acting, rotary actuators, air motors, **Valves:** Pressure Regulating Valves, Directional Control Valves, Flow Control Valves. methods of actuation, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, Signal **Processing Elements:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates. Pneumatic circuits for industrial applications & automation.	
Total Lecture	**33 Hours**

Text books:		
Title of the book	**Edition (Year of publication)**	**Author(s)**
Introduction to Fluid Power	2002	James L Johnson
Fluid Power With Applications	6th or above	Anthony Esposito
Industrial Hydraulics	3rdor above	J.J. Pipenger &T. G. Hicks
Pneumatic Systems: Principles and Maintenance	16th(2006)	S. R. Majumdar
Reference Books:		
Power pneumatics	(2007) or above	Michael J. Pinches
Vickers manuals on Industrial Hydraulics	3rdedition or above	Vickers
Hydraulics &Pneumatics	4thedition or above	Harry L. Stewart
Fluid Power Design Handbook	3rdedition or above	Franklin D. Yeaple

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://fada.birzeit.edu/bitstream/20.500.11889/6869/1/Abu_Hanieh_Fluid_Power_Control_ed2_Reduced.pdf
2	https://razak.utm.my/shamsul/wp-content/uploads/sites/189/2015/12/Fluid-Power.pdf
3	https://www.teachengineering.org/content/pur_/lessons/pur_fluidpower_less1/pur_fluidpower_lesson01_trainingmanualfluidpower.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/112/106/112106175/
2.	https://archive.nptel.ac.in/courses/112/106/112106300/
3.	https://onlinecourses.nptel.ac.in/noc24_me69/preview
4.	https://archive.nptel.ac.in/courses/112/105/112105047/

VI SEMESTER

22ME614 : PE I : Lab:- Industrial Fluid Power

Course Outcomes
Upon successful completion of the course the students will be able to ➢ To apply the fluid power laws and principals for analysis of simple fluid power systems and fluids. ➢ To identify, analyse, and justify selection of suitable components of fluid power system for specific applications based on its function, performance and working characteristics. ➢ To design and examine the fluid power system and to compose and interpret its circuit diagrams using standard symbols. ➢ To examine the safety measures, maintenance and troubleshooting for fluid power systems.

Minimum Eight Practical's to be performed from the list below

S. No.	**Experiments based on**
	List of Practical: Minimum eight experiments from the following:
	Experiments on Hydraulics Circuits:
1	Extend-Retract and Stop system of a linear actuator.
2	Regenerative circuit.
3	Speed Control circuits: meter-in, meter-out and bleed off.
4	Sequencing circuit
5	Use of solenoid operated DCV.
6	Traverse and Feed circuit.
	Experiments on Pneumatic Circuits:
7	Study of Compressor, FRL unit and 5/3 DCV.
8	Reciprocating motion of a single and a double acting actuator.
9	Speed control circuits.
10	Automatic to & fro motion of a pneumatic linear actuator.
11	Sequencing circuit.
12	Logical circuits.
	Other practical work:
13	Design **report** of a hydraulic or pneumatic system using **manufacturer's catalogue**.
14	Study of accumulators and intensifiers.
15	**Industrial visit** to study automation by means of hydraulic and pneumatics such as LPG bottling plant etc
16	Study of **compressed air generation and distribution** systems.
17	Study of **simple hydraulic systems** used in practice such as copy turning attachment, hydraulic clamps, jack, dumper, forklift etc.
18	Other circuits possible on the trainer kit, relevant to the syllabus

VI SEMESTER
22ME615 : PE I : I.C. Engines

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- The student will be able to Understand and analyze basic working cycles, construction and and systems of I.C. Engines.
- The student will be able to Analyze fuels, combustion process, pollution and its control of engines and evaluate rating of I.C. engine fuels
- The student will be able to Understand and analyze C. I. Engines and S. I. Engine.
- The student will be able to Analyze Engine performance of I C engine and evaluate by Heat balance sheet calculation.

Unit:1		**8 Hours**
Engines classification, Working cycles and operation, P-V, Valve Timing diagrams, Engine components and their material .Engine cycle Energy Balance, various losses in the engine like Frictional losses, blow by losses, pumping loss etc. Engine Lubrication systems, cooling systems and their importance.		
Unit:2		**7 Hours**
I.C.Engines fuel and its desirable properties. Requirements of S.I and C.I. Engine fuel Other fuel like CNG, LPG, Alcohols Rating of I.C. engine fuels		
Unit:3		**8 Hours**
Compressible fluid flow, Static and Stagnation properties, Isentropic flow, Flow of fluid through nozzles, Continuity equation, Variation of velocity, area and specific volume, Mass of discharge, Maximum discharge, Critical pressure ratio, Choking, Effect of friction, Nozzles and Diffusers efficiency, Back pressure effect, Super saturated flow. Fuel supply systems for S. I. Engine: A-F mixture requirements, Basic principle, Simple Carburetor and systems like main metering, choke, idle, acceleration pump. Operating difficulties for carburetors. Petrol Injection SPFI., MPFI, Direct Gasoline Injection, Ignition system & components for S.I.Engine - Battery, Magneto & Electronic.		
Unit:4		**8 Hours**
Combustion in S. I. Engine: Stages of combustion with p-θ diagram. Factors affecting various stages of combustion. Abnormal combustion Pre ignition, Detonation and Knocking. HUCR S.I.Engine combustion chamber.		
Unit:5		**7 Hours**
Fuel supply systems for C.I.Engine: Requirements of an ideal FI system, Types of Injection, Fuel injection pumps, fuel injectors and nozzles. Combustion in C. I. Engines. Stages of combustion with p-θ diagram, Factors affecting various stages of combustion. Abnormal combustion Diesel Knock, Supercharging and turbo charging in engine.		
Unit :6		**8 Hours**
Engine performance Parameters. MEP, Torque ,speed, power, Specific fuel consumption and various efficiencies., Air measurement, Excess air and Volumetric efficiency, Measurement and Testing of friction power ,indicated power, Brake power, Fuel consumption, Air consumption, etc. Heat balance sheet calculation. Air pollution from I.C.Engines and their control using EGR, Catalytic converters, particulate traps.		
	Total Lecture Hours	**45 Hours**

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Text books / Reference Books	
1	I. C. Engines by Heywood, 2017
2	I. C. Engines by Mathur & Sharma, Dhanpatrai, 2018
3	I. C. Engines by V.Ganeshan, Tata McGraw Hill, 2017
4	I. C. Engines by Domkundwar & Domkundwar, Dhanpatrai, 2018
5	I. C. Engines by R.K.Rajput, Laxmi Prakashan, 2017
6	I. C. Engines by R. Yadav, Central Pub., Allahabad, 2017
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://link.springer.com/book/10.1007/978-3-662-43715-5
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
3	https://onlinelibrary.wiley.com/doi/10.1002/9781119902973.ch4
4	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119902973?SeriesKey=10.1002/97804701042
MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/112106133
2	https://nptel.ac.in/courses/112103249

VI SEMESTER
22ME616 : PE I : Lab:- I.C. Engines

Course Outcomes:
Upon successful completion of the course the students will be able to ➢ Understand and analyze basic working cycles, construction and and systems of I.C. Engines. ➢ Analyze fuels, combustion process, pollution and its control of engines and evaluate rating of I.C. engine fuels ➢ Understand and analyze C. I. Engines and S. I. Engine. ➢ Analyze Engine performance of I C engine and evaluate by Heat balance sheet calculation.

Sr. No.	Experiments based on
1	Study and demonstration of working of 2-S & 4-S Engines.
2	Study and demonstration of Lubrication & Cooling systems.
3	Study of fuel systems for S.I. engines
4	Study of fuel systems for C.I. engines.
5	Determination of Air: Fuel ratio for Petrol Engine.
6	Determination of Air: Fuel ratio for Diesel Engine
7	Determination of BP/FP/IP of Engine.
8	Heat balance sheet calculation.
9	Visit to Automobile Industry / workshop.

VI SEMESTER
22ME617 : PE I : Advance Welding Techniques

Course Outcomes :
Upon successful completion of the course, the students will be able to; ➢ **Discuss** the concept of advance welding processes **Apply** to industry applications. ➢ **Identify** the parameters needed for welding and **Apply** to increase the durability of product. ➢ **Apply** the concept of soldering and brazing and cutting process through welding in Industrial applications. ➢ **Evaluate** welding defect through welding testing method.

Unit I:	**(8 Hrs.)**
High energy Density processes, Mode of metal transfer in welding, Use of Inert Gas, Gas Tungsten Arc welding, Gas Metal Arc welding, Electron Beam Welding, Principle Bead Welding geometry, Mediums of beam, Vacuum range, Laser Beam welding, Principle, Keyhole technique, applications, Laser materials, Gaseous Lasers. **Application based Case Study**	
Unit II:	**(7 Hrs.)**
Resistance Welding Methods, Variations in the process, Effect of current, Pressure and resistance on nugget quality, Expulsion of metal, Mushrooming of electrodes, Materials, Direct spot welding, two sides spot welding, multiple spot welding, Shunt current, Electrode material, Seam welding, Projection welding, Butt welding, Flash butt welding, applications.	
Unit III:	**(8 Hrs.)**
Solid state welding Processes, Classification, Forge Welding, Friction Welding, Principle, Variables affecting weld quality, Heat generated, Machines used, Ultrasonic welding, Principle, Diffusion Bonding., Explosive Welding.	
Unit IV:	**(7 Hrs.)**
Brazing, Soldering, ,Capillary action, wetting action, joint designs for sheet metal brazements, brazing filler wire, Butt Joint design for sheet metal brazements, brazing methods, filler materials in brazing, Soldering, materials solder combinations, soldering fluxes, Oxy-fuel welding with chemical reaction . Welding problems and remedies for ferrous and non-ferrous metals.	
Unit V:	**(7 Hrs.)**
Arc cutting, Flame cutting, Plasma cutting, Gouging, Plasma cutting with different gases, Comparision with Oxyacetylene cutting, Oxyacetylene cutting, colour codes for cylinder.Arc welding processes with consumable and non-consumable electrodes**,** Submerged arc welding	
Unit VI:	**(8 Hrs.)**
Welding defects, Weldment testing, Destructive and non destructive testing, Coupon, Determination of yield strengths, ultimate strength, visual Inspection, Dye Penetrant test, penetrants and developers, Eddy current testing, Ultrasonic testing, Magnetic particle Inspection , advantages and application of each method. Welding Procedure specifications, Welder qualification, **Application based Case Study**	
Total Lecture	**45 Hours**

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Textbooks:	
1.	Jackson, M.D., Welding Methods and Metallurgy, Charles Griffin & Company, London, 1967.
2.	AWS, American Welding Society, Volume I to V, Miami, 1982. 28

Reference Books:	
1.	George E. Linnert, Welding Metallurgy, GML Publications, South Carolina, U.S.A., 1994.
2.	Little LR, Welding and Welding Technology. Tata McGraw-Hill, New Delhi, 1980.
3.	R.S. Parmar, Welding Technology, Khanna Publication.
4.	Sindo Kou, " Welding Metallurgy" Wiley Publication, Singapore

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supported%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/112/103/112103263/
2.	https://www.youtube.com/watch?v=6nguX-cEsvw

VI SEMESTER
22ME618 : PE I : Lab: Advance Welding Techniques

Course Outcomes
Upon successful completion of the course, the students will be able to ➢ **Discuss** the concept of advanced welding processes **Apply** to industry applications. ➢ **Identify** the parameters needed for welding and **Apply** to increase the durability of product. ➢ **Apply** the concept of soldering and brazing and cutting process through welding in Industrial applications. ➢ **Evaluate** welding defects through welding testing method.

Minimum Ten practicals to be performed from the list below

SN	Experiments based on
1	Study of welding Technology.
2	Study of Welding Electrodes in Welding Processes.
3	Study of Effect of welding Parameters.
4	Demonstration of Oxy-fuel Welding.
5	Demonstration of Shielded Metal Arc Welding.
6	Demonstration of Gas Metal Arc Welding.
7	Demonstration of Gas Tungsten Arc Welding.
8	Study of Cold Metal Transfer (CMT) Arc Welding.
9	Study of Welding Defects.
10	Study of Weldment Testing.

VI SEMESTER

22ME619 : PE I : Computer Integrated Manufacturing

VI SEMESTER

22ME620 : PE I : Lab:- Computer Integrated Manufacturing

VI SEMESTER
22ME621 : PE I : Mechatronics

Course Outcomes:
Upon successful completion of the course the students will be able to:
CO1 Explain the basic elements of mechatronics system.
CO2 Analyze the functioning of sensors, transducers and actuators.
CO3 Analyze and evaluate the electronic elements such as digital circuits, AD convertors, etc.
CO4 Explain the basics of PLC

Unit:1	**MECHATRONIC SYSTEM ELEMENTS**	**06 Hours**
Computer Integration of Electro-Mechanical System, Virtual Instrumentation and Computer Monitoring and control Basics solid state components. Measurement system, Control system, Microprocessor based controllers & its applications, other applications with mechatronic approach, Building blocks of mechatronic system. Comparison between Traditional and Mechatronics approach **Contemporary Issues related to Topic**		
Unit:2	**SENSORS & TRANSDUCERS**	**9 Hours**
Classification, Performance terminologies, Displacement, Position & proximity sensors, Photo detectors, Optical encoders, Pneumatic sensor, Hall effect sensor, Velocity & motion sensors: Incremental encoder, Tachogenerator, Piezo electric sensors, Tactile sensors, Flow & temperature sensors: Ultrasonic sensors, Light sensors, Selection of sensors, Interference & noise in measurement. **Contemporary Issues related to Topic**		
Unit:3	**ACTUATION SYSTEMS**	**7 Hours**
Pneumatic & hydraulic actuation systems: System configuration, Control System & its elements, Linear actuators, Rotary actuators. Mechanical actuation: System types & its configuration, fixed ratio type, Invariant motion profile type, variator etc. Electrical actuation system types & configurations, Mechanical switches, Solid state switches, Solenoids. **Contemporary Issues related to Topic**		
Unit:4	**DIGITAL CIRCUITS**	**7 Hours**
Boolean algebra combinational circuits. (Adders, Subtractors, encoders, decoders, multiplexers, de – multiplexers, memory units: RAM, ROM, EPROM etc.), Sequential circuits (Latches, Flip-flops, Counters, Registers). **Contemporary Issues related to Topic**		
Unit:5	**ANALOG SIGNAL PROCESSING**	**7 Hours**
Amplifiers, Operational amplifiers, Ideal model for operational amplification, Inverting amplifier, Non-inverting amplifier, Summer, Difference amplifier, Instrumentation amplifier, Integrator, Differentiator, Sample & hold circuit, Comparator, Basics of filters, Types of filters, Introduction to A/D and D/A converters. **Contemporary Issues related to Topic**		
Unit :6	**ELECTRONIC SYSTEM DESIGN**	**7 Hours**
Introduction to MPU & MCU, Interfacing, Introduction to PLC & basics of PLC programming.General philosophy of Artificial Neural Network simulations, Fuzzy logic for operation and control of mechatronic systems. **Contemporary Issues related to Topic**		
Total Lecture Hours		**39 Hours**

Text books	
1	W. Bolton, Mechatronics, 4th Edition, Pearson Education (India), 2011.
Reference Books	
1	M. Mano, Digital Logic & Computer Design, 4th Edition, Pearson, 2016.
2	HMT Ltd., Mechatronics, 1st Edition, Tata McGraw Hill Publication, 2002
3	Necsulescu, Mechatronics, Pearson Education (Singapore), 2002.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://archive.nptel.ac.in/courses/112/103/112103174/
2	
MOOCs Links and additional reading, learning, video material	
1	https://onlinecourses.nptel.ac.in/noc21_me27
2	https://onlinecourses.nptel.ac.in/noc21_me129/preview

VI SEMESTER
22ME622 : PE I : Lab:- Mechatronics

Course Outcomes:
Upon successful completion of the course the students will be able to
1. Explain the basic elements of mechatronics system. 2. Analyze the functioning of sensors, transducers and actuators. 3. Analyze and evaluate the electronic elements such as digital circuits, AD convertors, etc. 4. Explain the basics of PLC

Experiments based on:

1) Introduction and development of a mechatronic system through a case study.
2) Performance and Demonstration on of operational amplifier.
3) Performance and Demonstration on of rotary encoders.
4) Speed measurement using magnetic pick up coil sensor on DAQ system.
5) Programmable Logic Controller (PLC),PLC Trainer system S7-1200
6) Development of ladder programming using PLC for road junction traffic light control system.
7) Development of ladder programming using PLC for water level control system
8) Development of ladder programming using PLC for washing machine.
9) Development of ladder programming using PLC for soft drink winding machine
10) Development of ladder programming using PLC for the lift simulation
11) Development of ladder programming using PLC for the pedestrian traffic light control system.
12) Development of ladder programming using PLC for any other suitable applications.

VI SEMESTER
22ME623 : PE I :Computer Graphics and Solid Modelling

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Distinguish the various CAD CAM tools and also evaluate criteria for CAD-CAM systems
- Design 2D and 3D Transformation matrices
- Calculate and analyze the parametric equations for the wireframe. surface and solid modeling entities
- Design the applications of modeling and evaluate data exchange formats

Unit I: CAD TOOLS	**(7 Hrs.)**
Definition of CAD Tools, Types of system CAD/CAM system evaluation Criteria, functional areas of CAD, Modeling and viewing, efficient use of CAD software. **Wireframe modeling** -Types of mathematical representation of curves, wire frame models, wire frame entities, parametric representation of analytical and synthetic curves – Hermite cubic splines, Bezier curves, B-Splines, rational curves-NURBS.	
Unit II: SURFACE MODELING	**(7 Hrs.)**
Mathematical representation of surfaces, Surface model, Surface entities, surface representation, parametric representation of surfaces, plane surface, ruled surface, surface of revolution, Tabulated surface.	
Unit III: PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES	**(7 Hrs.)**
Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation - Displaying, Segmentation, Trimming, Intersection, Transformations - 2D and 3D, Orthogonal and Perspective transformations.	
Unit IV: SOLID MODELLING	**(8 Hrs.)**
Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Design Applications: Introduction to Feature based and Assembly modelling.	
Unit V: ADVANCED MODELING CONCEPTS	**(8 Hrs.)**
Feature Based Modeling, Assembly Modeling, Behavioral Modeling, Conceptual Design & Top-down Design. Techniques for visual realism – hidden line – Surface removal – Algorithms for shading and Rendering. Parametric and variational modeling, Feature recognition, Design by features, Assembly and Tolerance Modeling, Tolerance representation – specification, analysis and synthesis, AI in Design.	
Unit VI: Lighting System and accessories	**(8 Hrs.)**
Evaluation of data- exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.	
Total Lecture	**45Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Text books:				
1	CAD/CAM, Theory & Practice	1st Edition (2991)	Ibrahim Zeid	McGraw-Hill
2	Procedural elements for computer Graphics	1st Edition (2998)	D Rogers	WCB/McGraw-Hill
3	Introduction to Finite Elements in Engineering	2nd Edition (2002)	Chandrupatla&Belegundu A.D	Prentice Hall
4	Optimization for Engineering Design	1st Edition (2005)	Kalyanmoy Deb	Prentice Hall
5	P. N. Rao,	-	CAD/CAM	McGraw Hill
6	Martenson, E. Micheal	2995	Geometric Modelling	John Wiley & Sons
7	P. Radhakrishnan, S. Subramanyam		CAD/CAM/CIM	New Age International

Reference Books:	
1.	Computer Graphics McGraw-Hill Hearn D. & Baker M.P Prentice Hall
2.	1st Edition (2990) RoggersDravid F., Adams J. Alan McGraw-Hill

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1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/107/106/107106088/

VI SEMESTER
22ME624 : PE I : Lab:- Computer Graphics and Solid Modelling

Course Outcomes
Upon successful completion of the course the students will be able to ➢ Distinguish the various CAD CAM tools and also evaluate criteria for CAD-CAM systems ➢ Design 2D and 3D Transformation matrices ➢ Calculate and analyze the parametric equations for the wireframe. surface and solid modeling entities ➢ Design the applications of modeling and evaluate data exchange formats

Minimum Ten Practical's to be performed from the list below

SN	**Experiments based on**
1	Observe and sketch the layout of a two wheeler transmission system.
2	Check the following electrical / electronic components, parameters of a two wheeler. CDI system components, Charging System components, Voltage at battery, specific gravity and high discharge test Use service/ operator's manual for specifications.
3	Adjust idle speed of a two wheeler engine using the specified procedure. Check the Idling Emission using Exhaust Gas Analyzer and do necessary carburetor adjustments for better performance.
4	Check the Ignition Timing of a two-wheeler and compare it with the Workshop/ Operators Manual Specification. Remove, observe, clean the Spark plug and adjust the gap and refit.
5	Remove and refit rear wheel of a two wheeler - check the conditions of brake shoes, brake drum, bearings etc. Perform brake adjustment. Replace brake cables, brake shoes/ pads.
6	Visit a Two wheeler Dealer Showroom/ Company showroom to obtain Chassis specification of a Scooter/ Motorcycle or scooterate. Share and Compare the data collected for two vehicles in the same category of vehicles (on the basis of Ground clearance, wheel base, engine power, spare wheel, claimed fuel efficiency, load carrying capacity). Prepare a report to identify the better one in the category.
7	Dismantle and assemble a motorcycle clutch and perform clutch adjustments. Replace clutch cable, if required.
8	Carry out lubrication and greasing of a vehicle. Engine, brake linkage, clutch linkage, fork, axle, chain and levers.
9	Demonstration of various components of battery and working of its charging system.
10	Demonstration to understand working principle of Electric horn, Brake light and side indicator.

VI SEMESTER
22ME625 : PE I :Two Wheeler technology

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Student will be able to Classify & Explain various systems of Engine, its function including fuel supply, cooling and lubrication system in a two wheeler.
- Student will be able to Analyze and explain various power transmission systems from clutch to wheel in a two wheeler.
- Student will be able to Student will be able to Classify and Compare control systems like steering, suspension and brakes in a two wheeler.
- Student will be able to explain and Recommend the necessary electrical and luxurious systems and safety system in a two wheeler.

Unit I: Frames, Body and Transmission system	**(7 Hrs.)**
Type of frames: Single cradle frame, Double cradle frame, Tubular frame (Single Down-tube frame using the engine as a stressed member), Body- Monocoque Construction. Selection of Transmission system components: Cable Actuated Wet Multi-disc clutch, Centrifugal clutch. Chain drive, Belt drive with variator mechanism, Gear drive. Working of Gear box: its comparison with four wheelers. Gear ratios in scooter and motorcycle. Working of Constant mesh gear box.	
Unit II: Engines, Fuel Supply System,	**(7 Hrs.)**
Two Stroke Engines - Arrangement of Ports in the cylinder, Decompression Valve arrangement. Four Stroke Engines - Overhead Valve and Overhead cam arrangements. Advantages of Multiple valves. Induction and Exhaust system: Marks Induction System, Air filter/ Air Cleaner: construction and function - Washable oiled sponge element, washable Dual foam wet type. Fuel supply system: Gravity feed and vacuum operated system. Down draught and horizontal/ Side draught carburetor. Carburetor functions and working under various Engine operating conditions like - Idling, Starting, accelerating, normal running. Advantages of electronic fuel injection system. Exhaust system.	
Unit III: Lubrication System and Emission Control System, Steering and Suspension System	**(7 Hrs.)**
Lubrication and Emission Control Systems: Lubrication system. Petrol Lubrication with Separate Oil Pump for Two stroke engines. Wet sump Pressurized Lubrication in four stroke engines. Block diagram and working of pollution control measures, Catalytic convertor, Exhaust Gas Recirculation, Positive Crankcase Ventilation. Handle Bar arrangement, Steering fork, Purpose of providing Caster angle. Use of Dampers/ Double acting type of shock absorbers. Use of Variable Rate coil spring, Coil in coil spring arrangement. Advantages of Mono-shock suspension system. Advantage of Gas filled shock absorber for rear end suspension.	
Unit IV: Brakes, Wheels and Tyres.	**(8 Hrs.)**
Drum (Mechanical Expanding Shoe type) and disc Brakes (Fixed Caliper and Floating Caliper types.), Mechanical and Hydraulic brakes. Lever operated and pedal operated brakes. Application and criteria for selection of wheels and tyres, their specification for motorcycles, scooters, sports bike.	
Unit V: Ignition and charging system	**(8 Hrs.)**
Ignition System: Working of Condenser Discharge Ignition (CDI) system. Microprocessor controlled Ignition system block diagram and working. Benefits of Twin Spark Ignition system Starting system and Charging System: Kick Start and Button Start arrangements. Components of starting system and their functions: D C motor, Battery, Battery Rating for use in Button start vehicles. Schematic circuit and working of charging system. Schematic diagram showing AC and DC circuits.	

Unit VI: Lighting System and accessories	(8 Hrs.)
Lighting System and accessories- Specifications and Application of Head Lamp, Tail and number plate Lamp, Purpose of using LED lights in tail lamp, Turn Signal Lamp, Side Stand Indicator Lamp, High Beam Indicator Lamp, Neutral Indicator Lamp, Speedometer Lamp, Horn, Mobile Charger point, Head lamp and tail lamp Reflectors used in two wheelers. Dash units: Use of Speedometer (Analog and digital), Trip meter. Use of Engine Speed indicator/ Tachometer.	
Total Lecture	**45Hours**

Textbooks:	
1.	Panchal Dhruv U., Two and Three wheeler Technology, PHI Learning, 2015.
2.	Singh Kirpal, Automobile Engineering, Volume 1 & 2, Standard publishers and distributers, 14th Edition, 2021

Reference Books:	
1.	Ganesan V, Internal Combustion Engines, 4th Edition, McGraw Hill Education, 2012.
2.	Rajpoot R K, A text book of Automobile Engineering, Laxmi publications (P) Ltd., 1st Edition, 2007.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/107/106/107106088/

VI SEMESTER
22ME626 : PE I : Lab:- Two Wheeler technology

Course Outcomes
Upon successful completion of the course the students will be able to ➢ Student will be able to Classify & Explain various systems of Engine, its function including fuel supply, cooling and lubrication system in a two wheeler. ➢ Student will be able to Analyze and explain various power transmission systems from clutch to wheel in a two wheeler. ➢ Student will be able to Student will be able to Classify and Compare control systems like steering, suspension and brakes in a two wheeler. ➢ Student will be able to explain and Recommend the necessary electrical and luxurious systems and safety system in a two wheeler.

Minimum Ten Practical's to be performed from the list below

SN	**Experiments based on**
1	Observe and sketch the layout of a two wheeler transmission system.
2	Check the following electrical / electronic components, parameters of a two wheeler. CDI system components, Charging System components, Voltage at battery, specific gravity and high discharge test Use service/ operator's manual for specifications.
3	Adjust idle speed of a two wheeler engine using the specified procedure. Check the Idling Emission using Exhaust Gas Analyzer and do necessary carburetor adjustments for better performance.
4	Check the Ignition Timing of a two-wheeler and compare it with the Workshop/ Operators Manual Specification. Remove, observe, clean the Spark plug and adjust the gap and refit.
5	Remove and refit rear wheel of a two wheeler - check the conditions of brake shoes, brake drum, bearings etc. Perform brake adjustment. Replace brake cables, brake shoes/ pads.
6	Visit a Two wheeler Dealer Showroom/ Company showroom to obtain Chassis specification of a Scooter/ Motorcycle or scooterate. Share and Compare the data collected for two vehicles in the same category of vehicles (on the basis of Ground clearance, wheel base, engine power, spare wheel, claimed fuel efficiency, load carrying capacity). Prepare a report to identify the better one in the category.
7	Dismantle and assemble a motorcycle clutch and perform clutch adjustments. Replace clutch cable, if required.
8	Carry out lubrication and greasing of a vehicle. Engine, brake linkage, clutch linkage, fork, axle, chain and levers.
9	Demonstration of various components of battery and working of its charging system.
10	Demonstration to understand working principle of Electric horn, Brake light and side indicator.

VI SEMESTER
22ME631 : PE II : Tool Design

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. Apply the fundamentals of Tool Design. 2. Apply the Design of various cutting tools, Sheet Metal Dies, Jigs / Fixtures and Forging dies . 3. Evaluate the failure modes of tools and costing. 4. Apply planning for manufacturing of tools for various components.

Unit I: Metal Cutting	**(8 Hrs.)**
Theory of metal Cutting Introduction, Mechanics of chip formation, Cutting tool materials, Single point cutting tool, Designation of cutting tools, ASA system, Importance of Tool angles, Orthogonal rake system, Classification of cutting tools, Types of chips, determination of shear angle, velocity relationship, force relations, Merchant's Theory, Cutting power, Energy consideration in metal cutting, Tool wear, Tool life, Tool life criteria, variable affecting tool life, **Application based case study**	
Unit II: Design of SPCT and Multiple Cutting Tool	**(8 Hrs.)**
Design of single Point Cutting Tool, Drills- Introduction, Types, Geometry, Design of drill. Milling cutters - Introduction, Types, Geometry, and Design of milling cutters	
Unit III: Press tool	**(7 Hrs.)**
Press tool Design Introduction, Press operations - Blanking, piercing, Notching, Perforating, Trimming, Shaving, Slitting, Lancing, Nibbling, Bending, Drawing, Squeezing. Press working equipment - Classification, Rating of a press, Press tool Equipment, arrangement of guide posts. Press selection, press working \Terminology, Working of a cutting die, Types of dies - Simple dies, inverted die, Compound dies, combination dies, progressive dies, Transfer dies, multiple dies, **Case of simple Die Design and its CAD Model**	
Unit IV: Bending and Drawing Die	**(8 Hrs.)**
Bending Forming & Drawing dies Bending methods - Bending Terminology, V- Bending, Air bending, bottoming dies, spring back & its prevention. Design Principles - Bend radius, Bend allowance, Spanking, width of die opening, Bending pressure. Metal flow during drawing, Design, Design consideration - Radius of draw die, Punch radius, Draw clearance, Drawing speed, Calculating blank size, Number of draws, Drawing pressure, Blank holding pressure	
Unit V: Forging	**(7 Hrs.)**
Forging Die Design: Introduction, Classification of forging dies, Single impression dies, Multiple Impression dies. Forging design factors - Draft, fillet & corner radius, parting line, shrinkage & die wear, mismatch, finish allowances, webs & ribs Preliminary forging operation - fullering, edging, bending, drawing, flattering, blacking finishing, cutoff. Die design for machine forging - determination of stock size in closed & open die forging.	
Unit VI: Jig and Fixture	**(7 Hrs.)**
Design of jigs & fixture: - Introduction, locating & clamping - principle of location, principle of pin location, locating devices, radial or angular location, V - location, bush location. Design principle for location purpose, principle for clamping purposes, clamping devices, design principles common to jigs	

& fixtures. Drilling Jigs: - Design principles, drill bushes, design principles for drill bushings, Types of drilling jigs - Template jig, plate type jig, open type jig, swinging leaf jig, Box type jig, channel type jig . Jig feet. Milling Fixtures: - Essential features of a milling fixtures, milling machine vice, Design principles for milling fixtures, Indexing jig & fixtures

Total Lecture	**45 Hours**

Textbooks:	
1.	Donaldson , "Tool design", Edition 2011, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi
2.	ASTME Hand book, "Fundamentals of Tool design", 1988 Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi,

Reference Books:	
1.	Pollock, "Fundamentals of Tool design" 1962, Reston Publishing Company
2.	Kempster, "Fundamentals of Tool design" , 1971, Hall of India Pvt. Ltd
3.	Rong , Yeming, " Computer aided fixture design", Marcel Dekker

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1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	http://www.digimat.in/nptel/courses/video/112105233/L13.html
2.	https://archive.nptel.ac.in/courses/112/105/112105233/

VI SEMESTER
22ME632 : PE II : Additive Manufacturing

Course Outcomes:

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

1. Understand current technology and additive manufacturing trends, the working principles, and process parameters of additive manufacturing processes
2. Explore different additive manufacturing processes and summarise them with materials, suggesting suitable methods
   for building a particular component.
3. Design and develop a working model using different techniques.
4. Discuss the contemporary issues in processing software/algorithms and testing.

Unit:1	**Additive Manufacturing (AM) Overview:**	**8 Hours**

- Introduction to AM, AM evolution, Distinction between AM & CNC machining, Product development cycle, Rapid prototyping, Reverse Engineering, Industry 4.0 design principle - future with AM, smart manufacturing, current industry and manufacturing trends driving AM, Printing process, other applications, and Future trends.

Contemporary Issues related to Topic: (May be covered in TA/Case Study)

- Generalized additive manufacturing steps.

Unit:2	**AM Technologies & Limitations of AM Systems:**	**7 Hours**

- Classification of AM technologies, AM process parameters, VAT photopolymerization, Material jetting (MJ), Binder jetting, Material extrusion, Powder bed fusion, Sheet lamination, Directed Energy Deposition (DED), New AM technologies,
- Laser & electron beam theory concept- types & properties, Potential Hazards of Additive Manufacturing.

Contemporary Issues related to Topic: (May be covered in TA/Research Paper Study/Visit)

- Other advanced methods can be covered.

Unit:3	**Materials Science for AM:**	**8Hours**

- Types of materials in AM, Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure-property relationship.
- Wire Properties for DED, Powder Properties for PBF, DED, and BJ, Methods of Powder particle production, Mechanical properties of AM printed parts, Defects, Form, fit, function trade-off, time and cost

Contemporary Issues related to Topic: (May be covered in TA/Research Paper Study/Visit)

- Case studies should be discussed and assigned for more clarification.
- A case study on non-destructive testing can be discussed/given for the printed part.

Unit:4	**CAD Models for AM:**	**7 Hours**

- CAD file formats, CAD CAM software, Modelling and Data Processing, Solid modeling (Introduction-Types), Tessellation, error minimization, firmware interface with 3-D Models,
  STL File: Introduction-data structure- ASCII-Binary-resolution-deviation & angle tolerance, Manipulation of

STL files: Orientation of STL file-support structure-optimal part orientation, topology optimization & techniques, Steps for build file preparation, Issues with STL file format. Cost for additive manufacturing, waste identification, cost categories, and cost models.

Contemporary Issues related to Topic: (May be covered in TA/Visit)

- Transport phenomena models and numerical modeling of the AM process can be covered.

Unit:5	**Process Planning for AM:**	**8 Hours**

- Pre-processing, In-Situ processing, Post-processing, Quality standards for AM, Build strategies, Minimum feature size, Surface finish, and Elimination of support structures.
- Guidelines for internal geometry like flow paths, cooling channels, cavities, and others, Guidelines for making lightweight objects, and Guidelines for making functionally gradient objects **Contemporary Issues related to Topic: (May be covered in TA/Visit)**
- A case study on selection methods for a part may be planned.

Unit:6	**Slicing Software's and Algorithms:**	**7Hours**

- Classification Slicing methods, Tool path planning, Area filling methods, Slicing Software, Algorithms: Uniform slicing-Stair-step effect- Adaptive Slicing-Curved Layer Slicing- Direct Slicing, etc.

Contemporary Issues related to Topic: (May be covered in TA/Research Paper Study/Visit)

- Case Studies and Application of software/algorithms in AM.

Total Lecture Hours	**45 Hours**

Text books:

1	Additive Manufacturing Technologies, Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W Rosen,Bent Stucker, Springer New York 2010.
2	3D Printing and Additive Manufacturing: Principles and Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.
3	A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf,A xel Nordin and Damien Motte, Springer, 2020.
4	Laser Assisted Fabrication of Materials, J D Majumdar and I Manna, Springer Series in Material Science.
5	Understanding Additive Manufacturing: Rapir Prototyping, Rapid Tooling, Rapid Manufacturing, Andreas Gebhardt, Hanser Publishers, 2011.
6	Numerical Modeling of the Additive Manufacturing Process of Titanium Alloy, ., Zhiqiang Fan and Frank Liou, In Tech, 2012
7	Laser-induced Materials and Processes for Rapid Prototyping, L Lu, J Fuh and Y S Wong, Kluwer Academic Press, 2001
8	Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D T Pham, S S Dimov, Springer 2001
9	Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006
10	Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & amp: Francis Group, 2020
11	Additive Manufacturing: Principles, Technologies and Applications, C P Paul, A N Junoop, McGraw Hill, 2021.

Reference Books:	
1	Rapid Prototyping, Laser-based and other technology, Patri K. Venuvinod and Weiyin Ma, Springer 2004.
2	The 3 D Printing Handbook: Technologies, Design and Applications, Redwood, Ben, Filemon Schoffer and Brian Garret, 3 D Hubs, 2017
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
MOOCs Links and additional reading, learning, video material	
1	https://onlinecourses.nptel.ac.in/noc21_me115/preview
2	https://onlinecourses.nptel.ac.in/noc22_me130/preview
Online resources:	
1	https://www.nist.gov/additive-manufacturing
2	https://www.metal-am.com/
3	http://additivemanufacturing.com/basics/
4	https://www.3dprintingindustry.com/
5	https://www.thingiverse.com/
6	https://reprap.org/wiki/RepRap
7	https://courses.gen3d.com/courses/enrolled/988400
8	https://markforged.com/resources/blog/design-for-additive-manufacturing-dfam
9	https://www.hubs.com/knowledge-base/how-design-parts-metal-3d-printing/
10	https://www.rapidmade.com/design-for-additive-manufacturing
11	https://all3dp.com/1/design-for-additive-manufacturing-dfam-simply-explained/#where-to-learn-dfam

VI SEMESTER
22ME633 : PE II : Fuel Cell Technology

Course Outcomes:

successful completion of the course, the students will be able to;

1. **Apply** knowledge of performance, behavior, operational issues and challenges for all major types of fuel cells for its commercialization.
2. **Investigate and Apply** know-how of thermodynamics, electrochemistry, heat transfer, and fluid mechanics principles to design and analysis of this emerging technology.
3. **Design & analyze** innovative fuel cell systems, fuel cell charge transport and mass transport, the techniques, skills, and modern engineering tools necessary for design and analysis.
4. **Examine and evaluate** the methodology to design the components of fuel cells and specific type of fuel cell systems.

Unit I: Introduction to Fuel Cells	**(8 Hrs.)**
Brief history of fuel cells, Operating principles, Types of fuel cells- Solid Oxide Fuel Cell (SOFC), Alkaline Fuel Cell (AFC), Molten Carbonate Fuel Cell (MCFC), Phosphoric Acid Fuel Cell (PAFC), Fuel Cell Stack, Advantages, Limitations and Applications of Fuel Cell, Polarization curve for performance characterization of fuel cells, Representing various losses (Activation, Ohmic ,concentration loss), Hydrogen Production, Storage and Transportation.	
Unit II: Fuel Cell Thermodynamics	**(7 Hrs.)**
Heat Potential (Enthalpy of Reaction), Work Potential (Gibbs free energy), Reversible fuel cell voltage (Nernst equation), Fuel Cell Efficiency	
Unit III: Fuel Cell Electrochemistry	**(8 Hrs.)**
Electrochemical Reaction basics, Faraday's law, Tafel equation, Butler- Volmer equation, Exchange current	
Unit IV: Fuel Cell Charge Transport and Mass Transport	**(7 Hrs.)**
Ion Transport (Electrolyte), Electron Transport, Gas phase (single phase) mass transport in different fuel cell components (Diffusion layer, flow channels), Multiphase Mass Transport in fuel cell components, Fuel Crossover and Internal Currents, Heat generation and transport in fuel cell	
Unit V: Fuel Cell Characterization	**(8 Hrs.)**
In Situ Versus Ex Situ Characterization, Polarization Test, Electrochemical Impedance Spectroscopy, Linear Sweep Voltammetry, Cyclic Voltammetry, Current Interrupt, High frequency resistance	
Unit VI: Polymer Electrolyte Membrane Fuel Cell (PEMFC)	**(7 Hrs.)**
Components and Materials: Membrane, Catalyst Layer, Bipolar Plate, Current Collector, Water Management, Thermal Management, Direct Liquid Fuel Cell (DLFC), Advantage of Liquid Fuel over Gaseous Fuel, Different types of DLFC, Direct Methanol Fuel Cell (DMFC)	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	O'Hayre, R.P.,S. Cha, W. Colella, F.B.Prinz, Fuel Cell Fundamentals, Wiley, NY (2006)
2.	J. Larminie and A. Dicks, Fuel Cell Systems Explained, 2nd Edition, Wiley (2003)
3.	Matthew M. Mench, Fuel Cell Engines , Wiley (2008)
4.	Introduction to Fuel Cells Electrochemistry and Materials, San Ping Jiang , Qingfeng Li, Springer (2022)

Reference Books:	
1.	X. Li., Principles of fuel cells, Taylor & Francis (2005)
2.	S. Srinivasan, Fuel Cells: From Fundamentals to Applications, Springer (2006)

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/book%20details/ME.aspx
2	https://link.springer.com/chapter/10.1007/978-981-10-7626-8_3

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/103/102/103102015/
2.	https://nptel.ac.in/courses/103108162
3.	https://www.energy.gov/

VI SEMESTER
22ME634 : PE II : Material Handling Systems

Course Outcomes:
Upon successful completion of the course, the students will be able to;
1. Explain the principles and functions of various material handling systems
2. Apply material handling principles to design basic handling systems for specific applications.
3. Analyze the efficiency and effectiveness of different material handling methods in various scenarios.
4. Evaluate the performance of material handling systems considering safety, efficiency, and cost factors.

Unit I:	**(8 Hrs.)**
Types of intra-plant transporting facility, principles of material handling and classification of material handling equipment, selection of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipment, general characteristics of surface and overhead equipment and their applications. Introduction to control of hoisting equipment.	
Unit II:	**(7 Hrs.)**
Component selection and design Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains, hemp rope and steel wire rope, selection of ropes, rope reeving arrangement and pulley blocks fastening of chains and ropes, different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems. Chain and ropes heaves and sprockets	
Unit III:	**(8 Hrs.)**
Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, Electromagnetic lifting system, grabbing attachments for loose materials, crane attachments for handling liquid materials.	
Unit IV:	**(7 Hrs.)**
Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thrusters operated, controlled brakes, shoe brakes, Electro-Hydraulic thrusters safety handles, load operated constant force and variable force brakes, Rope drum design and assembly, design of guides and column	
Unit V:	**(8 Hrs.)**
Different drives of hoisting gears like individual and common motor drive for several mechanisms, travelling gear, travelling mechanisms for moving trolleys and cranes on runway rails, mechanisms for trackless, rubber tyre and crawler cranes, motor propelled trolley hoists and trolleys, rails and travelling wheels, slewing, jib and lifting gears .Operation of hoisting gear during transient motion, selecting the motor rating and determining braking torque for hoisting mechanisms, selecting the motor rating and determining braking torque for travelling mechanisms, slewing mechanisms, jib and lifting mechanisms. (Elementary treatment is expected)	

Unit VI:	**(7 Hrs.)**
Cranes with rotary pillar, cranes with a fixed post, jib cranes with trolley, portal cranes with luffmg boom, cantilever cranes, cage elevators, safety devices of elevators, belt and chain conveyors and their power calculations, vibrating and oscillating conveyors, pneumatic and hydraulic conveyors, screw conveyors ,hoppers, gates and feeders. Introduction to AGV's as new material handling device, use of robot for material handling	
Total Lecture	**45 Hours**

Textbooks:	
1.	**"Introduction to Materials Handling"** John A. White, Marvin H. Agee, Kenneth E. Case **Publisher:** John Wiley & Sons
2.	**"Material Handling Systems: Designing for Safety and Health"** Charles Reese CRC Press

Reference Books:	
1.	**"Principles of Material Handling"** Ray A. Kulwiec John Wiley & Sons
2.	**"Material Handling Handbook"** Raymond A. Kulwiec John Wiley & Sons

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/book%20details/ME.aspx
2	https://link.springer.com/chapter/10.1007/978-981-10-7626-8_3

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/103/102/103102015/
2.	https://nptel.ac.in/courses/103108162
3.	https://www.energy.gov/

VI SEMESTER
22ME635 : PE II : Reliability Engineering

Course Outcomes :
Students will be able to: 1. Interpret Reliability, Maintainability, and Availability of engineering systems. 2. Apply Reliability Modeling as a tool for evaluating system performance. 3. Analyze the failure of a machine and the failure rate of systems or components 4. Create production & maintenance schedules of particular engineering systems using various tools used for failure data analysis.

Unit I: Fundamental concepts	**(8 Hrs.)**
Reliability definitions, failure, Failure density, Failure Rate, Hazard Rate, Mean Time To Failure, MTBF, maintainability, availability, safety and reliability, Quality, cost and system effectiveness, Life characteristic phases, modes of failure, Quality and reliability assurance rules, product liability, Importance of Reliability,	
Unit II: Probability theory:-	**(7 Hrs.)**
Set theory, laws of probability, total probability theorem, probability distributions, parameters and applications.	
Unit III: System reliability and modelling:	**(7 Hrs.)**
Series and parallel components, mixed configuration, complex systems. Redundancy, element redundancy, unit redundancy, standby redundancy. Types of standby redundancy, parallel components. Markov models for reliability estimation.	
Unit IV: Maintainability and Availability:	**(8 Hrs.)**
Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system downtime. Availability - Inherent, Achieved, and Operational availability, reliability, and maintainability trade-off. Markov models for availability estimation.	
Unit V: System Reliability Analysis:	**(7 Hrs.)**
Reliability allocation or apportionment. Reliability apportionment techniques. Reliability block diagrams and models. Reliability predictions. Life testing and accelerated testing.	
Unit VI: Strength-based reliability:	**(8Hrs.)**
Safety factor, safety margin, Stress strength interaction, Failure Mode, Effects and Criticality Analysis-, , FMECA examples, Ishikawa diagram .fault tree construction, basic symbols development of functional reliability block diagram, Fault tree analysis, fault tree evaluation techniques, Design of Mechanical components and systems:-Material strengths and loads.	
Total Lecture	**45 Hours**

Reference books:	
Text Books	
1	Concepts of Reliability Engg 1985 L.S. Srinath Affiliated East-Wast Press (P) Ltd
2	Reliability Engineering 1983 A.K. Govil Tata McGraw-Hill Publishing Co. Ltd
3	Reliability Engineering 1984 E. Balagurusmy Tata McGraw-Hill Publishing Co. Ltd
Reference Books	
1	Engineering Reliability 1980 B.S. Dhillion, C. Singh John Wiley & Sons
2	Probabilistic, Reliability 1968 M.L. Shooman McGraw-Hill Book Co.,
3	Reliability in Engineering Design 1977 K.C. Kapur, L.R. Lamberson John-Wiley and sons.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
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VI SEMESTER
22ME636 : PE II : Bio- Mechanics

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. To acquaint the knowledge of mechanics of biological system . 2. To enable them to understand its applications in developing mathematical models. 3. To enable them to understand its applications in developing mechanical aspects of designing implants 4. To enable them to understand its applications in developing biological assistive devices.

Unit I: Introduction of Mechanics:	**(7 Hrs.)**
Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplaner & Noncoplaner and Concurrent & non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.	
Unit II: Biomechanics of Joints:	**(7 Hrs.)**
Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee andankle.	
Unit III: Biofluid Mechanics : Hard Tissues: Soft Tissues:	**(8 Hrs.)**
Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. **Hard Tissues** Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle; Modeling of soft tissues: Cartilage, Tendon, Ligament, and Muscle, Hills's muscle model	
Unit IV: Cardiovascular Mechanics:	**(7 Hrs.)**
Bending Cardiovascular system, artificial heart valves, biological and mechanical valves development, testing of valves, Blood Flow Models, Blood Vessel Mechanics, Heart Valve Dynamics, Prosthetic Valve Dynamics.	
Unit V: Respiratory Mechanics:	**(7 Hrs.)**
Mechanism of air flow, respiratory cycle, lung ventilation model, methods of determining pressure, flow rate and volume;spirometry.	
Unit VI: Applied Biomechanics: and Biomechanics of Implants:	**(9 Hrs.)**
Applied Biomechanics: Engineering approaches to standing, sitting and lying, Biomechanics of gait, application of gait and locomotion analysis, Fluid mechanics and energetics: Forms of energy and energy transfer. **Biomechanics of Implants:** Design of orthopaedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	N. Ozkaya and M. Nordin, Fundamentals of Biomechanics-Equilibrium, Motion and Deformation, springer-verlag, 2nd edition 1999
2.	Duane knudson, Fundamental of biomechanics, springer, 2nd edition 2007
3	D. J. Schneck and J. D. Bronzino, Biomechanics- Principles and Applications, CRC Press,2ndEdition, 2000

Reference Books:	
1.	Y C Fung, Biomechanics: Mechanical Properties of Living Tissues, springer, 2nd edition, 1993.
2.	Hiroshi Wada, Biomechanics at Micro and Nano scale Levels, volume 1, 2005, World Scientific Publishing Co. Pt. Ltd.
3.	Mow, Van C.; Huiskes, Rik, Basic Orthopaedic Biomechanics and Mechano-Biology, 3rd Edition,2005, Lippincott Williams & Wilkins
4	Joseph D, Bronzino, "The Biomedical Engineering Handbook", CRC Press, 3rd edition, 2006.
5	Roger Bartlett, Introduction to Sports Biomechanics 1997, Roger Bartlett, Taylor & Francis Group

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/78.%20Engineering-Mechanics-Statics-and-Dinamics-E-W-Nelson-C-L-Best-W-G-McLean-1st-Ed-1997-Schaum-Outline-McGraw-Hill%20(1).pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
3	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	http://www.digimat.in/nptel/courses/video/112105233/L13.html
2.	https://archive.nptel.ac.in/courses/112/105/112105233/

VI SEMESTER
22ME637 : PE II :Composites

Course Outcomes :
Upon successful completion of the course, the students will be able to 1. Explain the roles of matrix and reinforcement materials in composites and how their properties affect the overall performance of the composite. 2. Apply knowledge of composite manufacturing techniques to identify appropriate fabrication processes for different composite applications. 3. Analyze the mechanical behavior of composite materials under various loading conditions and predict failure mechanisms. 4. Design composite structures using principles of micromechanics and macromechanics, and perform structural analysis using computational tools.

Unit I: Introduction to Composite Materials	**(8 Hrs.)**
Definition and Classification: Understanding what composites are, and how they are classified. **History and Development**: Evolution of composite materials and their role in various industries. **Advantages and Disadvantages**: Pros and cons of using composite materials over traditional materials. **Applications**: Key applications in aerospace, automotive, civil engineering, sports, and more.	
Unit II: Constituent Materials	**(7Hrs.)**
Matrix Materials: Types of matrix materials (polymers, metals, ceramics), their properties, and selection criteria. **Reinforcement Materials**: Types of reinforcement materials (fibers, particulates, whiskers), their properties, and forms (continuous, short, woven, etc.). **Interfaces and Interphases**: Importance of the interface, surface treatments, and the role of interphase in composites.	
Unit III: Fabrication Processes	**(7 Hrs.)**
Manufacturing Techniques: Overview of various fabrication methods (hand lay-up, spray-up, filament winding, pultrusion, resin transfer molding, etc.). **Process Parameters**: Key parameters affecting the quality and performance of composites. **Advances in Fabrication**: Recent developments and innovations in composite manufacturing.	
Unit IV: Mechanical Behavior and Properties	**(8 Hrs.)**
Stress-Strain Relationships: Understanding the mechanical behavior of composites under different loading conditions. **Failure Mechanisms**: Types of failures in composites (matrix cracking, fiber breakage, delamination) and their prediction. **Mechanical Testing**: Standard testing methods (tensile, compressive, flexural, impact, fatigue) and interpretation of results.	
Unit V: Micromechanics and Micromechanics	**(7 Hrs.)**
Micromechanics of Composites: Analysis at the fiber and matrix level, including rule of mixtures, volume fractions, and micromechanical models. **Micromechanics of Laminates**: Classical laminate theory, stress and strain distribution in laminates, and	

composite plate theories. **Structural Analysis**: Analysis techniques for composite structures using finite element methods (FEM).	
Unit VI: Durability and Performance	**(8 Hrs.)**
Environmental Effects: Impact of environmental factors (temperature, moisture, UV exposure) on composite materials. **Long-term Performance**: Creep, fatigue, and aging in composites. **Nondestructive Evaluation (NDE)**: Techniques for assessing the integrity of composites (ultrasound, X-ray, thermography, etc.). **Sustainability and Recycling**: Life cycle analysis, recycling methods, and the environmental impact of composites.	
Total Lecture	**39 Hours**

Textbooks:	
1.	**Composite Materials: Science and Engineering** by Krishan K. Chawla
2.	**Mechanics of Composite Materials** by Robert M. Jones
3.	**Engineering Mechanics of Composite Materials** by Isaac M. Daniel and Ori Ishai

Reference Books:	
1.	**Introduction to Composite Materials** by Stephen W. Tsai and Hyer C. Miller
2.	**Principles of Composite Material Mechanics** by Ronald F. Gibson

VI SEMESTER
22ME638 : PE II : Data Analytics In Mechanical Engineering

Course Outcomes :
Upon successful completion of the course, the students will be able to:

Unit I: Introduction to Data Analytics in Mechanical Engineering (Difficulty Level: Beginner)	**(8 Hrs.)**
Overview of Data Analytics - Definition of data analytics, Importance and benefits in mechanical engineering, Historical context and evolution, Applications in various mechanical engineering domains, importance and applications of Data Analytics in Mechanical Engineering, Statistical Concepts and Techniques - Descriptive statistics: mean, median, mode, variance, standard deviation, Probability distributions: normal, binomial, Poisson, Inferential statistics: hypothesis testing, confidence intervals, Data Visualization Techniques - Graphical representation of data: histograms, scatter plots, box plots, Importance of visualization in understanding data patterns, Tools and software for data visualization: Excel, MATLAB, Python libraries (matplotlib, seaborn) **Case Studies:** 1. Analyzing temperature variations in a heat exchanger using Excel or MATLAB 2. Predictive maintenance analysis for rotating machinery using Python and Pandas	
Unit II: Data Preprocessing and Cleaning (Difficulty Level: Intermediate)	**(8 Hrs.)**
Data Preprocessing Techniques - Data cleaning: handling missing values, duplicates, and inconsistencies Data transformation: normalization, standardization, Feature scaling and selection, Handling Missing Data - Techniques for imputation of missing values: mean imputation, interpolation, deletion, Impact of missing data on analysis and interpretation, Outlier Detection and Treatment - Identification of outliers using statistical methods and visualization techniques, Strategies for handling outliers: trimming, winsorization, transformation **Case Studies:** 1. Cleaning and preprocessing sensor data from a manufacturing plant using Python and NumPy 2. Detecting and handling outliers in vibration data from a rotating machine using MATLAB or R	
Unit III: Descriptive and Inferential Statistics (Difficulty Level: Intermediate)	**(7 Hrs.)**
Descriptive Statistics - Measures of central tendency: mean, median, mode, Measures of dispersion: range, variance, standard deviation, Skewness and kurtosis: interpretation of data distribution, Inferential Statistics - Hypothesis testing: formulation of null and alternative hypotheses, p-values, Confidence intervals: interpretation and construction, Regression analysis: linear regression, multiple regression, logistic regression, Regression Analysis - Model building and interpretation, Assumptions of regression analysis, Model evaluation metrics: R-squared, adjusted R-squared, AIC, BIC **Case Studies:** 1. Analyzing the relationship between engine parameters and fuel efficiency using regression analysis in Excel or Python 2. Hypothesis testing to compare the performance of two manufacturing processes using R or MATLAB	
Unit IV: Machine Learning Fundamentals (Difficulty Level: Intermediate)	**8 Hrs.)**
Introduction to Machine Learning - Basic concepts and terminology: supervised learning, unsupervised learning, reinforcement learning, Types of machine learning algorithms: classification, regression, clustering, Supervised Learning - Regression techniques: linear regression, polynomial regression, support vector regression Classification techniques: logistic regression, decision trees, random forests, Unsupervised Learning - Clustering algorithms: K-means clustering, hierarchical clustering, Dimensionality reduction techniques: principal	

component analysis (PCA), t-distributed stochastic neighbor embedding (t-SNE), Model Evaluation and Validation Techniques - Cross-validation methods: k-fold cross-validation, leave-one-out cross-validation Performance metrics: accuracy, precision, recall, F1-score, ROC curve

Case Studies:

1. Predicting mechanical properties of materials using regression algorithms in Python with scikit-learn
2. Clustering analysis of production line data to identify patterns using MATLAB or R

Unit V: Advanced Data Analytics Techniques (Difficulty Level: Advanced)	**(7 Hrs.)**

Time Series Analysis and Forecasting - Time series data: components and patterns, Techniques for time series forecasting: moving averages, exponential smoothing, ARIMA models, Seasonal decomposition and trend analysis, Feature Engineering and Selection - Feature extraction techniques: PCA, LDA, feature hashing
Importance of feature selection in model building, Wrapper, filter, and embedded methods for feature selection, Ensemble Learning Methods - Bagging techniques: bootstrap aggregating, random forests, Boosting techniques: AdaBoost, gradient boosting, Stacking ensemble models, Introduction to Deep Learning - Basics of neural networks: architecture, activation functions, optimization algorithms, Deep learning frameworks: TensorFlow, Keras, PyTorch, Applications of deep learning in mechanical engineering

Case Studies:

1. Forecasting equipment failure using time series analysis in Python with TensorFlow or Keras
2. Feature selection for optimizing manufacturing processes using ensemble learning methods in R or MATLAB

Unit VI: (Difficulty Level: Advanced)	**(7 Hrs.)**

Predictive Maintenance in Manufacturing - Concept and benefits of predictive maintenance, Data-driven approaches for predicting equipment failures, Implementation challenges and best practices, Quality Control and Process Optimization - Statistical process control (SPC) techniques, Six Sigma methodology for process improvement, Optimization algorithms: genetic algorithms, simulated annealing, Design Optimization and Simulation - Computer-aided design (CAD) and finite element analysis (FEA), Optimization techniques for product design, Sensitivity analysis and robust design optimization

Case Studies:

1. Predictive maintenance of HVAC systems in a commercial building using Python and TensorFlow
2. Optimization of automotive component design using simulation and data analytics in ANSYS or MATLAB

Total Lecture	**45 Hours**

Textbooks:

1. Machine Learning for Sustainable Manufacturing in Industry 4.0: Concept, Concerns and Applications, by Raman Kumar (Editor), Sita Rani (Editor), Sehijpal Singh Khangura (Editor), Publisher : CRC Press; 1st edition (3 November 2023), Language : English, Hardcover : 234 pages, ISBN-10 : 103239305X, ISBN-13:978-1032393056
2. Data Analytics for Process Engineers: Prediction, Control and Optimization (Synthesis Lectures on Mechanical Engineering) Hardcover – Import, 3 December 2023, by Daniela Galatro (Author), Stephen Dawe (Author), Publisher : Springer International Publishing AG; 1st ed. 2024 edition (3 December 2023), Language : English, Hardcover : 145 pages, ISBN-10 : 3031468651, ISBN-13 : 978-3031468650

Reference Books:

1. Data Analytics: Handbook of Formulas and Techniques, Adedeji B. Badiru, CRC Press, 22 Dec 2020 - Technology & Engineering - 272 pages
2. Predictive Analytics for Mechanical Engineering: A Beginners Guide, Parikshit N. Mahalle, Pravin P. Hujare, Gitanjali Rahul Shinde, SpringerBriefs in Applied Sciences and Technology,

	https://doi.org/10.1007/978-981-99-4850-5, Publisher-Springer Singapore, eBook ISBN 978-981-99-4850-5 Published: 16 August 2023
3.	Data Analytics for Process Engineers, Daniela Galatro, Stephen Dawe, Series Title-Synthesis Lectures on Mechanical Engineering, https://doi.org/10.1007/978-3-031-46866-7, Publisher-Springer Cham, eBook ISBN 978-3-031-46866-7 Published: 02 December 2023

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
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3	
MOOCs Links and additional reading, learning, video material	
1.	Data Analysis and Decision Making - I By Prof. Raghu Nandan Sengupta | IIT Kanpur https://onlinecourses.nptel.ac.in/noc24_mg14/preview
2.	Data Science for Engineers By Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan | IIT Madras https://onlinecourses.nptel.ac.in/noc21_cs69/preview
3.	Dealing with materials data : collection, analysis and interpretation By Prof. M P Gururajan, Prof. Hina Gokhale | IIT Bombay https://onlinecourses.nptel.ac.in/noc21_mm09/preview

VI SEMESTER
22ME639 : PE II : Advanced Manufacturing Techniques

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. **Distinguish and Identify** the various non-traditional manufacturing process based on energy sources. 2. **Evaluate** various advanced manufacturing process for new materials and the requirements of complex features on the basis of various parameters. 3. **Justify** various advanced welding techniques for different welding applications. 4. **Illustrate** the applications of additive manufacturing techniques in industries.

Unit I: Mechanical Processes	**(8 Hrs.)**
Need, classification of AMT, Abrasive jet Machining, Water jet Machining & ultrasonic Machining, Abrasive-Water Jet Machining, Abrasive Flow Machining, Magnetic Abrasive Finishing & Ultrasonic Machining. Contemporary issues	
Unit II: Chemical Processes.	**(6 Hrs.)**
Chemical Processes & Electro-chemical Processes: Electrochemistry of ECM, tool design, effect of variable on performance chemical milling, Chemical Engraving, Photo chemical machining, EC grinding. Contemporary issues	
Unit III: Thermo-electric Processes	**(9Hrs.)**
Electric Discharge Machining, Wire Electric Discharge Machining. Electron Beam Machining, Laser Beam Machining, Ion Beam Machining & Plasma Arc Machining. Contemporary issues	
Unit IV: HERF	**(6 Hrs.)**
High energy rate forming processes: Burnishing, ballizing process and other miscellaneous forming processes, electroforming. Thermoform High velocity forming, Vacuum forming.. Contemporary issues	
Unit V: Unconventional welding techniques	**(9 Hrs.)**
Laser beam welding , electron beam welding, plasma arc welding, atomic hydrogen welding, submerged arc welding, explosive welding techniques. solid phase welding technique such as ultrasonic welding, friction welding. Contemporary issues	
Unit VI: Additive Manufacturing	**(7 Hrs.)**
Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing. Contemporary issues	
Total Lecture	**45 Hours**

Textbooks:	
1	Ghosh and Malik, Manufacturing sciences, OAFFO, 2010.
2.	Gary F. Benedict , Non traditional processes Talyor and francis, CRC Press , 1ed,2019.
3	V. K. Jain, Advanced Machining Processes, Allied Publishers,4th Edition (2009)

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Reference Books:	
1.	J. A. McGeough, Advanced Methodes of machining , Chapman and Hall ,1988.
2.	Cherry Lemon , , Advanced Methodes of machining , M Hill Didactics Co, 2019.
3.	Paul and Jinoop , Additive Manufacturing , Mc Graw hill, 2021.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/112/107/112107078/
2.	https://archive.nptel.ac.in/courses/112/107/112107077/
3.	https://archive.nptel.ac.in/courses/112/107/112107078/

VI SEMESTER
22ME651 : PE III : Artificial Intelligence

Course Outcomes :
Upon successful completion of the course the students will be able to
1. Examine the issues involved in knowledge bases, reasoning systems and planning
2. Design and evaluate intelligent expert models for perception and prediction from intelligent environment.
3. Apply AI frameworks and platforms to improve business, organizational, and technology outcomes.
4. Analyze the concept of neural networks for learning linear and non-linear activation functions

Unit I:	**(6 Hrs.)**
Human and machine intelligence, Artificial Intelligence (AI), Programming in AI environment, Natural Language processing (NLP), Need of AI.	
Unit II:	**(7Hrs.)**
Architecture of an Expert system, Knowledge base, inference engine forward and backward chaining, use of probability and fuzzy logic. Selection of inference mechanism.	
Unit III:	**(7 Hrs.)**
Neural Network and application artificial neural network models, NN applications in Cellular manufacturing and other areas of mechanical Engineering	
Unit IV:	**(6 Hrs.)**
Introduction to Rule Based System. Conflict Resolution Advantages and Drawbacks of Rule Based Systems Clausal Form Logic, Rule Base Verification, Refinement and Validation. Creating Knowledge Base, Knowledge Engineer and Domain Expert, Phases of Knowledge Engineering, Tools for Knowledge Engineering.	
Unit V:	**(7 Hrs.)**
Fundamentals of OOP (Object oriented programming), creating structures and objects, object operations, invoking procedures, programming applications, Object oriented expert systems.	
Unit VI:	**(6 Hrs.)**
Semantic nets, structure and objects, ruled systems for semantic nets, certainty factors, Learning	
Total Lecture	**39 Hours**

Textbooks:	
1.	Elaine Rich "Artificial Intelligence" McGraw Hill Education; 3rd edition (1 July 2017)
2.	Addis, T.R., ―Designing Knowledge Based System‖, Prentice Hall, 1985.
3.	Rolston, D.W., ―Principles of Artificial Intelligence and Expert Systems Development‖, McGraw Hill, 1988.

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Reference Books:	
1.	Maus, R. and Keyes, J., ―Handbook of Expert Systems in Manufacturing‖, McGraw Hill, 1991
2.	Robert Levine, ―A comprehensive guide to artificial intelligence and expert systems",Elain Rich ,‖Artificial Intelligence‖,
3.	Sasikumar, Ramani, et al ,‖Rule based expert systems‖.
4.	Graham Winstanley, ―Program Design for Knowledge Based Systems‖, Galgotia Publications
5.	Artificial Neural Networks", Zurada
6.	V.B. Rao and H.V. Rao, ―C++ : Neural Networks and Fuzzy Logic‖, BPB Publications.

VI SEMESTER
22ME652 : PE III : Design for Manufacturing & Assembly

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. Evaluate the product life cycle, select the materials and manufacturing processes for designed product. 2. Analyze and apply the various design rule related to machining, casting and joining for designed product. 3. Analyze the different requirements of Automated assembly 4. Analyze and apply the various design rule related to manual assembly for designed product.

Unit I: Introduction	**(6 Hrs.)**
Design philosophy steps in Design process — General Design rules for manufacturability— basic principles of design Ling for economical production—creativity in design. Materials: Selection of Materials for design Developments in Material technology—criteria for material selection—Material selection interrelationship with process selection process selection charts.	
Unit II: METALCASTING	**(6 Hrs.)**
Appraisalofvariouscastingprocesses,selectionofcastingprocess,-generaldesignconsiderations for casting—casting tolerances—use of solidification simulation in casting design—product design rules for casting	
Unit III: MACHININGPROCESS	**(7 Hrs.)**
Over view of various machining processes—general design rules for machining-Dimensional tolerance and surface roughness— Design for machining— Ease— Redesign in go components for machining ease with suitable examples. General design recommendations for machined parts	
Unit IV: METALJOINING	**(7 Hrs.)**
Appraisal of various welding processes, Factors in design of weldments—general design guidelines —pre and post treatment of welds—effects of thermal stresses in weld joints—design of brazed joints. Forging— Design factors for Forging— Closed die forging design— partinglinesofdie5 drop forging die design—general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections- design principles for Punching, Blanking, Bending, and Deep Drawing— Keeler Goodman Forming Line Diagram—Component Design for Blanking.	
Unit V: ASSEMBLY	**(6 Hrs.)**
Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation. **Automatic Assembly Transfer Systems**: Continuous transfer, intermittent transfer, indexing mechanisms, and operator- paced free–transfer machine	
Unit VI: DESIGNOFMANUALASSEMBLY	**(7 Hrs.)**
Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time	
Total Lecture	**45 Hours**

Textbooks:	
1	GeoffreyBoothroyd,"AssemblyAutomationandProductDesign",MarcelDekkerInc.,NY,2992.
2	EngineeringDesign–Material&ProcessingApproach–GeorgeE.Deiter,McGrawHillIntl.2ndEd.2000.

Reference Books:	
1	A Delbainbre"ComputerAidedAssemblyLondon,2992
2	

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
3	

MOOCs Links and additional reading, learning, video material	
1.	
2.	
3.	

VI SEMESTER
22ME653 : PE III : Renewable Energy System

Course Outcomes:
Upon successful completion of the course, the students will be able to; 1. CO-01: Understand (BL-2), analyze (BL-4), and explain (BL-5) the physics and geometry of solar radiation along with its estimation (BL-6) (measurements). 2. CO-02: Identify (BL-3), analyze (BL-4), and explain/ evaluate (BL-5) various solar energy collectors, y and utilizing (BL-5) the knowledge of solar energy for useful applications. 3. CO-03: Understand (BL-2), analyse (BL-4), and justify (BL-5) the use of wind, Ocean, geothermal and Biomass energy with appropriate evaluation (BL-5) and discussion (BL-6). 4. CO-04: Understand (BL-2), analyze (BL-4), and discuss (BL-6) the concept of Magneto Hydro Dynamic power generation, fuel cell and Hydrogen as fuel.

Unit I:	**(8 Hrs.)**
Solar Energy: Introduction, solar constant, spectral distribution of solar radiation, beam & diffuse radiation, measurement of solar radiation and measuring instruments. Solar radiation geometry. Types of solar collectors, Flat Plate & Concentrating Collectors. Application of Solar Energy.	
Unit II:	**(7 Hrs.)**
Biogas and Biomass: - Types of Biogas plants, Methods of Biogas generation, factors affecting the biogas generation. **Gasifiers:** classification of gasifiers & basic constructional details and basic chemistry of gasification.	
Unit III:	**(8 Hrs.)**
Wind energy: - Basic principle of wind energy conversion, wind velocity and power from wind; Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multiblade system. Vertical axis- Savonius and Darrieus types. applications of wind energy. Site selection, Merits & demerits of wind power generation.	
Unit IV:	**(7 Hrs.)**
OTEC & Tidal energy: Introduction: - Principle of working, Rankine cycle, ocean thermal electric conversion open and closed cycle of OTEC, hybrid cycle, energy from tides basic principles of tidal power & components of tidal power plants, single & double basin arrangement, estimation of tidal power and energy, Advantages & Limitation of Tidal Power, Energy from ocean waves -energy availability, wave energy conversion devices.	
Unit V:	**(7 Hrs.)**
Geothermal power generation: Geothermal energy: Introduction, Thermal Gradient Resources of Geothermal Energy: Hydrothermal, Petro-Geothermal, Geopressured sources, thermodynamics of geo- thermal energy conversion-electrical conversion, classification of geothermal systems vapour dominated system, liquid dominated system, total flow concept, Merits and Demerits of Geothermal Energy Sources, applications of geothermal energy.	

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Unit VI:	**(8 Hrs.)**
Magneto Hydro Dynamic power generation: Introduction, working principles of MHD power generation, MHD open and closed systems, power output from MHD generators, design problems of MHD generation, gas conductivity, seeding, Application of MHD Power generation. **Hydrogen & Fuel cells:** Concept, key components, basics of physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, basic design of PEMFC system. basics of hydrogen production, Storage, Transportation and Safety.	
Total Lecture	**45 Hours**

Textbooks:

SN	Author Name	Title	Publication
1.	Dr. S. P. Sukhatme	Solar Energy	Tata McGraw Hill
2.	Parulekar & Rao	Energy Technology	Khanna Publishers
3.	G D Rai	Non-Conventional Energy Sources	Khanna Publishers
4.	S. Hasan Saeed, D. K. Sharma	Non-Conventional Energy Sources	S. K. Kataria & Sons
5	G. N. TIWARI & M. K. GHOSHAL	RENEWABLE ENERGY RESOURSES	NAROSA PUBLISHING HOUSE
6	B H Khan	Non-Convention Energy Resources	McGraw Hill Education (India) Pvt. Ltd. 3rd Edition
7	D.P. Kothari, R. Rakesh and K.C. Singal,	Renewable Energy Resources and Emerging Technologies,	2nd Edition, Prentice India Pvt. Ltd, 2011.
8	G.S. Sawhney,	Non-Conventional Energy Sources,	1st Edition, Prentice India Pvt. Ltd, 2012.
9	Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala	FUNDAMENTALS AND PPLICATIONS OF RENEWABLE ENERGY	McGraw Hill Education (India)

Reference Books:

SN	Author Name	Title	Publication
1.	John A. Duffie, William A. Beckman	Solar Energy	Wiley
2.	Jui Sheng Hsieh	Solar energy engineering	Prentice-Hall
3	Ashok V Desai	Non-Conventional Energy	Wiley Eastern Ltd, New Delhi 2003
4	Ramesh R & Kumar K U	Renewable Energy Technologies	Narosa Publishing House New Delhi
5	N.K. Bansal, Manfred Kleeman & Mechael Meliss	Renewable Energy Sources and Conversion Technology	Tata McGraw Hill. 2004

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	E-book URL: https://www.pdfdrive.com/non-conventional-energy-sources-e10086374.html
2	E-book URL:https://www.pdfdrive.com/non-conventional-energy-systems-nptel-d17376903.html
3	E-book URL: https://www.pdfdrive.com/renewable-energy-sources-and-their-applications- e33423592.html
4	E-book URL: https://www.pdfdrive.com/lecture-notes-on-renewable-energy-sources-e34339149.html

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc21_me34/preview
2.	https://archive.nptel.ac.in/content/syllabus_pdf/121106014.pdf
3.	https://onlinecourses.nptel.ac.in/noc22_ch66/preview
4	https://nptel.ac.in/courses/103103206
5	https://onlinecourses.nptel.ac.in/noc22_ge14/preview
6	https://nptel.ac.in/courses/108108078

VI SEMESTER
22ME654 : PE III : Plastics and Composite

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. **IDENTIFY** of preparation and properties of polymers. 2. Understand and A**pply** the various molding techniques and also Generalize the basic concepts in mould design 3. Understand and **Apply** suitable machining and joining of plastic materials. 4. Understand and A**pply** suitable plastic composite fabrication technique

Unit I: Chemistry and Classification of Polymers	**(8 Hrs.)**
Properties of Thermo Plastics - Properties of Thermosetting Plastics - Applications - Merits and Disadvantages Definition - Addition and Condensation Polymerization, case study	
Unit II: Study of Extrusion, Casting and Blow Molding	**(7 Hrs.)**
Extrusion - Blow Molding – Casting – Thermo Forming – Rotomolding Study of molds. Case study	
Unit III: Study of Compression, Injection and Transfer Molding	**(8 Hrs.)**
Compression and Transfer Molding - Injection Molding- study of compression and injection molding moulds Case study	
Unit IV: General Machining properties of Plastics	**(7 Hrs.)**
Machining Parameters and Their effect - Joining of Plastics -Mechanical Fasteners - Thermal bonding - Press Fitting. Testing of plastic. Case study	
Unit V: Fibers - Glass, Boron, Carbon, Ceramic, and Metallic Fibers	**(8 Hrs.)**
Matrix Materials - Polymers, Metals and Ceramics. Open Mould Processes, Bag Molding, Compression Molding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting - Injection Molding - Application of PMC's. Case study	
Unit VI: Solid State Fabrication Techniques and Liquid State Fabrication Method	**(7 Hrs.)**
Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapor Deposition of Matrix on Fibers - Liquid State Fabrication Methods - Infiltration - Squeeze Casting - Rheo Casting - Compocasting - Application of MMCS. Case study	
Total Lecture	**45 Hours**

Textbooks:	
1.	F.ohannaber., Injection Moulding Machines, Hanser Publishers,, 1983.
2.	F.Hensen., Plastics Extrusion technology, 1988
3.	C.Rauwendaal,, Polymer extrusion, Hanser Publishers, 1990.
4.	D.V.Rosatao., Blow Moulding Handbook., Hanser Publishers,
5.	S Kalpakjian& SR Schmid ., Manufacturing Engineering & Technology., Pearson Education Canada., 6st Edition (2013)

Reference Books:	
1.	Akira Kobyashi., Machining of Plastics., Mc-Graw Hill., 1981
2.	E.B Seamour., Modern Plastics Moulding., John Wiley.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=nGfVTNfNwnk
2.	https://www.youtube.com/watch?v=6nguX-cEsvw

VI SEMESTER
22ME655 : PE III : Tribology in Manufacturing

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. **IDENTIFY** of preparation and properties of polymers. 2. Understand and A**pply** the various molding techniques and also Generalize the basic concepts in mould design 3. Understand and **Apply** suitable machining and joining of plastic materials. 4. Understand and A**pply** suitable plastic composite fabrication technique

Unit I: Introduction	**(8 Hrs.)**
Introduction to tribology, History of tribology, Interdisciplinary Approach, Economic Benefits.	
Unit II:Friction	**(7 Hrs.)**
Causes of Friction, Adhesion Theory, Abrasive Theory, Junction Growth Theory, Laws of Rolling Friction, Friction Instability.	
Unit III: Wear	**(8 Hrs.)**
Wear Mechanisms, Adhesive Wear, Abrasive Wear, Corrosive Wear, Fretting Wear, Wear Analysis	
Unit IV: Lubrication and Lubricants	**(7 Hrs.)**
Importance of Lubrication, Boundary Lubrication, Mixed Lubrication, Full Fluid Film Lubrication;Hydrodynamic, Elastohydrodynamic lubrication, Types & Properties of Lubricants, Lubricants Additives.	
Unit V: Fluid film lubrication	**(8 Hrs.)**
Fluid mechanics concepts, Equation of Continuity & Motion,Generalised Reynolds Equation with Compressible & Incompressible Lubricants.	
Unit VI: Application Tribology	**(7 Hrs.)**
Introduction, Rolling Contact Bearings, Gears, Journal Bearings - Finite Bearings.	
Total Lecture	**45 Hours**

Textbooks:	
1.	Dowson D, History of Tribology, Longman London, 1979.
2.	Stachowiak G N, Batchelor A W and Stachowick G B "Experimental methods in Tribology", Tribology Series 44, Editor D Dowson, 2004.
3.	Michael M Khonsari, Applied Tribology (Bearing Design and Lubrication),John Wiley & Sons, 2001.

Reference Books:	
1.	Jost H P, Lubrication (Tribology) : A Report on the present position and industry`s needs, Her Majesty`s Stationary Office, London, 1966.
2.	J Halling, Principles of Tribology, The Macmillan Press Ltd, London, 1975
3	Archard J F and Hirst W, The Wear of Metals under Unlubricated Conditions, Proc. R. Soc., London, A 236, 397-410, 1956.

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1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=nGfVTNfNwnk
2.	https://www.youtube.com/watch?v=6nguX-cEsvw

VI SEMESTER
22ME656 : PE III : Finance & Cost Management

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. Analyze the cost of the product 2. Analyze the financial balance sheet. 3. Evaluate the overhead cost. 4. create new products from waste or scrap

Unit I: Business Finance	**(8 Hrs.)**
Need for finance, sources of finance (fixed and working capital), equity and preference shares, deposits from public, debentures, bonds, term loans, financial institutions in India, Financial statements and their analysis	
Unit II: Concept of Cost	**(7 Hrs.)**
Concept of cost, classification of cost, direct and indirect , fixed and variable , semi variable, product and period, controllable and uncontrollable costs, opportunity costs , sunk cost, joint cost, prime cost, factory cost, cost of production, selling and distribution cost, administrative cost, cost of sales	
Unit III: Cost ascertainment and cost reduction	**(8 Hrs.)**
Concept of overhead, collection of overheads, allocation and appointment, absorption of overheads, absorption rates, under – over absorption , cost centers, cost units, cost statement sheet. Areas of cost reduction, techniques, productivity	
Unit IV: Costing System	**(7 Hrs.)**
Job costing, contract costing, cost plus contracts, batch costing, process costing, simple process costing, normal abnormal losses and gains, waste, scrap & spoilage, joint & byproducts, operating costing	
Unit V: Cost Planning and Control	**(8 Hrs.)**
Concept of budgeting, advantages and limitations, budgetary control, key factors, fixed and flexible budget. Standard costing, selling of standards, variance analysis.	
Unit VI: Decision Making	**(7 Hrs.)**
Marginal costing, break even analysis, cost volume, profit analysis, application of costing to various decisions like make or buy, add or drop products, cost or process further, operate or shut down, replace or retain	
Total Lecture	**45 Hours**

Text books:				
S.N.	**Title of the book**	**Edition (Year of publication)**	**Author(s)**	**Publisher**
1	Principles and Practice of Cost Accounting	Fifth edition	N.K. Prasad	Pearson Education
2	Management Accountancy	Third edition2010	J. Batty	Tata Mc Graw Hill
3	Financial Management	2007	Prasanna Chandra	Tata Mc Graw Hill
Reference books:				
1	Engineering Economy	1973	Paul Degarmo	Macmillan, 1973
2	Cost Accounting	2008	B.K.Bhar	Academic publishers
3	Costing and finance management	2012	Mrunalini Naik	Thakur publications

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1	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/79.%20Engineering%20Mechanics.%20Statics-%20MERIAM%20%20AND%20KRAIGE.pdf
2	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/e-copies%20of%20books/Civil%20Engineering/81.%20Engineering%20Mechanics%201.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=nGfVTNfNwnk
2.	https://www.youtube.com/watch?v=6nguX-cEsvw

VI SEMESTER
22ME657 : PE III : Maintenance Management

Course Outcomes:
Upon successful completion of the course the students will be able to
1. **CO1: Apply and Demonstrate** the maintenance function, , classification and condition monitoring of mechanical systems
2. **CO2: Analysed** the failure of a machine and plan the maintenance program for equipments.
3. **CO3: Calculate** repair and maintenance cost and evaluate maintenance performance **CO4: Interpret** maintenance needs of mechanical devices and assistance of CAMS.

Unit:1	**Introduction**	**7 Hours**
Maintenance – basic concepts, purpose, functions and objectives of maintenance, Principles, benefits and effects of maintenance, Inter-relationship between productivity, quality, reliability and maintainability, maintenance productivity ,quality in maintenance. Reliability, basic concepts, bathtub curve, failure rate, mean time before failure. System reliability, reliability of series and parallel systems. Maintainability, mean time to failure, mean time to repair. Availability–Contemporary Issues related to Topic		
Unit:2	**Types of Maintenance**	**7 Hours**
Maintenance strategies / systems–type – basis for selection. Breakdown maintenance, corrective maintenance. Preventive maintenance, Predictive maintenance. Reliability cantered maintenance (RCM), replacement policies-cyclic replacement, group replacement, standbys, economics of machine replacement, , Dismantling and assembling, Inspection and adjustments, Lubrication, maintenance welding, maintenance machining, , material improvement, maintenance cleaning		
Unit:3	**Condition Based Maintenance**	**7 Hours**
Condition based maintenance and condition monitoring – monitoring systems. Performance monitoring – visual, tactile and aural monitoring, leakage monitoring. Temperature monitoring Thickness monitoring, acoustic monitoring Smell / odour monitoring. Vibration monitoring –vibration analysis. Vibration transducers– types. Lubricant monitoring filter debris analysis spectroscopic oil analysis, Contemporary Issues related to Topic		
Unit:4	**Failure analysis**	**6 Hours**
Failure analysis: Defect and failure – definitions – basics of failures – failure generation – failure analysis. Fault tree analysis (FTA), Event tree analysis (ETA), Root cause analysis (RCA), Failure modes and effects analysis (FMEA), Failure mode effect criticality analysis, , Contemporary Issues related to Topic		
Unit:5	**Advanced Maintenance**	**7 Hours**
Total productive maintenance (TPM) , basic systems of TPM, TPM and terotechnology. Six sigma maintenance. Lean maintenance – 5-zero maintenance concept, 5-S maintenance conceptsix pillars, and success factors. Maintenance effectiveness, overall equipment effectiveness, key performance indicators, maintenance performance measuring indices, , Contemporary Issues related to Topic		
Unit :6	**Maintenance planning and scheduling**	**7 Hours**
Maintenance planning and scheduling. Maintenance organization, objectives and characteristics centralized and decentralized maintenance. Maintenance costs, classification of maintenance costs – maintenance cost analysis cost effectiveness analysis.– preparation of maintenance budget, Approach towards computerization, selection and scope of computerization, equipment classification, preventive maintenance and repair planning module, material management module, captive engineering shop module, Contemporary Issues related to Topic		
	Total Lecture Hours	**39 Hours**

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Text books	
1	Industrial Maintenance management by S.K.Shrivastava, S.Chand Publication

.**Reference books:**

S.N.	Title of the book	Edition (Year of publication)	Author(s)	Publisher
1	Maintenance engineering handbooks	2008	Mobley and Higgins	Mc-graw Hill
2	Guide to Complete Maintenance	1988.	Rolston, D.W	Heintzelment
3	Maintainability and maintenance management	1991	J. Patton	Maus, R. and Keyes
4	Total Productive Maintenance by Terry Wireman , Industrial Press, 2004 (http://www.books24x7.com/)	Total Productive Maintenance by Terry Wireman , Industrial Press, 2004 (http://www.books24x7.com/)	Total Productive Maintenance by Terry Wireman , Industrial Press, 2004 (http://www.books24x7.com/)	Total Productive Maintenance by Terry Wireman , Industrial Press, 2004 (http://www.books24x7.com/)
5	Introduction to reliability and maintainability Engineering.	--	Thomos Ebelling	Mc-graw Hill
6	Advanced operations management		R.P.Mohanty and S.G.Deshmukh	Pearson Education

VI SEMESTER
22ME671 : OE III : Operations Research Techniques

Course Outcomes:
Upon successful completion of the course the students will be able to
1. Recognise the importance of Optimisation in solving practical problems in industry.
2. Formulate real world decision making scenarios in to mathematical models.
3. Understand Operations Research models and apply them in the field of manufacturing, finance, Project management, human resource management etc.
4. Use optimisation tools to solve a mathematical model for a practical problem.

Unit:1	Linear Programming Problems:	**7 Hours**
Introduction to Linear Programming Problems: Formulation of LPP, Geometry of LPP and Graphical Solution of LPP, Simplex Method, Big M- Method, Two Phase Method **Contemporary Issues related to Topic**		
Unit:2	Transportation Problem:	**8 Hours**
Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method. Assignment Model **Contemporary Issues Related to Topic**		
Unit:3	Dynamic programming:	**8Hours**
Dynamic programming characteristics, approach and its formulations. Application of Dynamic programming in Employment smoothening problem, Resource allocation, Inventory control & Linear programming. **Contemporary Issues related to Topic**		
Unit:4	Project Management:	**7 Hours**
Project Management: Network Scheduling by CPM & PERT, Cost considerations in PERT and CPM **Contemporary Issues related to Topic**		
Unit:5	Replacement Models:	**8Hours**
Replacement Models: Replacement of Models that deteriorate with time, Concept of equivalence, Interest Rate and Present worth. Replacement of items that fails suddenly considering Individual and Group replacement policy. **Contemporary Issues Related to Topic**		
Unit :6	Queuing Theory and Simulation:	**7 Hours**
Queuing Theory: Queuing Systems, Kendelalls for representing queuing models, Classification of queuing models (No derivations expected), Simulations, Monte- Carlo Simulation. **Contemporary Issues related to Topic**		
	Total Lecture Hours	**45 Hours**

Text books	
1	Taha,H.A., "An Introduction to Operations Research", 6th Ed.,Prentice Hall of India, 2001
Reference Books	
1	Hillier, F.J., Lieberman, G.J., "Introduction to Operations Research"7th Ed., Holden Day Inc., 2001
2	Gross, D., and Harris, C.M., "Fundamentals of Queuing Theory", 2nd Ed., John Wiely & sons, NY, 1985
3	Panneer selvam R., Operations Research, PHI, 2011
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

VI SEMESTER
22ME672 : OE III : Automobile Engineering

Course Outcomes:

Upon successful completion of the course the students will be able to

1. analyze various systems of Engine, its function including fuel supply, cooling and lubrication system in vehicle.
2. describe various power transmission systems from clutch to wheel in vehicle.
3. evaluate and describe control systems like steering and brakes in vehicle.
4. illustrate and describe the necessary electrical and luxurious systems and safety system in vehicle.

Unit:1	Power Plant	8 Hours

Introduction, classification, history & development of Automobiles. Vehicles layout, Various engine systems and components, construction & working of I.C. engines.
Introduction to Fuel supply system: for Petrol and Diesel Engine, CRDI, GDI, EFI, MPFI, Engine fuels: Gasoline, diesel, bio-diesel, CNG.
Engine cooling and lubrication systems.

Contemporary Issues related to Topic : Power system : electrical, hybrids, solar, wind, compressed air, fuel cell, hydrogen etc.

Unit:2	Transmission	8 Hours

Clutch: Necessity, requirements & Types of a clutch
Gear box: Classification, Necessity & working principle of gear box, Propeller shaft, Slip & Universal joints.
Differential: Need and working, Differential lock, Rear Axles and Front Axles.

Contemporary Issues related to Topic: Introduction to Automatic Transmission: Fully and Semi-automatic.

Unit:3	Steering, Suspension & Brakes	8 Hours

Steering systems: principle of steering, steering linkages, steering geometry and wheel alignment, steering gear box and its types.
Suspension systems: Function, conventional and Independent suspension System, shock absorber.
Brakes: Drum and Disc brakes, Comparison, Mechanical, hydraulic, Air brakes.

Contemporary Issues related to Topic: Power steering

Unit:4	Wheels & vehicle dynamics	7Hours

Wheel and Tyres: Construction & classification of wheels & Tyres, tyre specification, factors affecting tyre performance.
Resistance to vehicle motion: Air, Road and gradient resistance and power calculation, Low and high speed turning, tyre cornering forces, Vehicle aerodynamics and its necessity.
Contemporary Issues related to Topic: Race car aerodynamics

Unit:5	Electrical systems	7 Hours
Electrical systems: Battery construction. Specification. Operation of Batteries. Charging of battery, Alternator, Starting system, Battery Ignition and magneto ignition systems, Lighting, Horn, Side indicator, wiper, and other electrical systems, Automobile air-conditioning, Panel Board instruments. **Contemporary Issues related to Topic:** Introduction to EV's		
Unit :6	**Maintenance & Safety**	**7 Hours**
Engine overhauling, Engine tune up, Tyre rotation & balancing, Fault detection techniques and remedies. Collision avoidance system and vehicle to vehicle communication, Airbags system, EBD, ABS and other safety features, cruise control. **Contemporary Issues related to Topic:** Navigation system and control.		
	Total Lecture Hours	**45 Hours**

Text books	
1	Singh Kirpal, Automobile Engineering, Volume 1 & 2, Standard publishers and distributors, 14th Edition, 2021
Reference Books	
1	Ganesan V, Internal Combustion Engines, 4th Edition, McGraw Hill Education, 2012.
2	Rajpoot R K, A text book of Automobile Engineering, Laxmi publications (P) Ltd., 1st Edition, 2007.
3	Sethi H M, Automotive Technology, McGraw-Hill Education, 1991
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

VI SEMESTER
22ME673 : OE III : Robotics and Subtractive Manufacturing

Course Outcomes:
Upon successful completion of the course, the students will be able to 1. Understand workings of subtractive manufacturing 2. Implement CNC programs for various product manufacturing 3. have knowledge of Robotics, automation, robotics motion, sensors, robotic programming and roles of robots in the industry 4. Understand the working methodology of robotics and automation, motion and control, machine vision and programming, and application of robots in industry.

Unit:1	**8 Hours**
Concepts of NC, CNC, DNC. Classification of CNC machines, MCU architecture and functionality, Machine Configurations, Types of control, CNC controller's architecture and characteristics, Interpolators.	
Unit:2	**7 Hours**
Positioning system, Cutter offset compensation, Word address format, Introduction to G and M codes Manual part programming for CNC turning, milling and drilling.	
Unit:3	**8 Hours**
Tooling system for Machining center and Turning center, work holding devices, of CNC Machines. APT part programming, CAD/CAM programming, Simulation and Verification of CNC programs, Adaptive CNC control techniques. Integration of CNC machines for CIM.	
Unit:4	**7 Hours**
Robot – Definition – Robot anatomy – Co-ordinate systems, work envelope, types and classification – Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions – Need for robots – Different applications.	
Unit:5	**8Hours**
Forward kinematics – Inverse kinematics – Differences: Forward kinematics and Reverse kinematics of manipulators with two and three degrees of freedom (In 2 dimensional), four degrees of freedom (In 3 dimensional) – Deviations and problems ,Introduction to DH notations	
Unit :6	**7 Hours**
ROBOT PROGRAMMING Teach pendant programming – Lead through programming – Robot programming languages – VAL programming – Motion commands – Sensor commands – End effecter commands – Simple programs. **IMPLEMENTATION** Implementation of robots in industries – Various steps - Safety considerations for robot operations.	
Total Lecture Hours	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
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Text books	
1	Robot Engineering An Intergrated approach 2004 Klafter R.D., Chmielewski T.A. and Negin M Springer
2	Industrial Robotics: Technology, Programming and Applications, 2012 Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta 2nd Edition, Tata McGraw Hill, 2012.
3	Automation in Production system 2002 Mikell P. Groover Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
Reference Books	
1	CNC Technology and Programming 2003 Krar, S., and Gill Industrial Press Inc
2	An Introduction to CNC Machining 1991 Gibbs, D. Industrial Press
3	Computer Numerical Control Concepts and Programming 1991 Seames, W.S. Thomson Learning EMEA, Limited
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
MOOCs Links and additional reading, learning, video material	
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

VI SEMESTER
22ME674 : OE III : Control System Engineering

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Illustrate the mathematical representation of various control system and determine the transfer function of mechanical, electrical, thermal and fluid system.
- Analyse the working of various control system components of electrical motor and hydraulic system..
- Evaluate the performance of control system using time response analysis.
- Create the performance of control system on the basis of frequency response and root locus and design suitable compensation for the control system.

I	Introduction:- Introduction, System concept Open and Closed loop control systems. Transfer function, Mathematical Modelling of Physical System and system representation through Block Diagram. Transfer function through Block Diagram Simplification. Signal Flow Graph, Masons Gain Formula Block diagrams of various control systems. (CO-1)
II	Mathematical Modelling:- Representation of Control components: Mechanical and Electrical components; Analogous systems. (CO-1)
III	Electrical system:- Ac/dc servomotors; field controlled and armature-controlled servomotors; positional servomechanisms, Potentiometer, Synchro, stepper motors. Hydraulic systems: - Hydraulic pumps (gear; vane; and reciprocating piston) Cylinders, Direction control valves (2, 3, 4 way) Flow control valve; Relief valve Hydraulic servomotor (CO-2)
IV	Time response analysis:- Transient and steady state response of first and second order systems Concept of stability; relative stability; Routh stability criteria. (CO-2)
V	Bode and Polar plot:- Frequency response and its characteristics; Bode plots; Polar plots, Nyquist plots. Gain margin and phase margin. Identification of system transfer function (CO-3)
VI	Root Locus:- Basic control actions; Proportional Integral and Derivative control actions and their effect on system performance. Root locus technique. Introduction to control system design log load compensation Feed Back Compensation and Pole -Zero placements (CO-4
	Total Lecture : 45 Hours

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Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Text books	
1	Modern Control Engineering 3rd Edition (2009) Ogata Prentice Hall
2	Control system Engineering 4th Edition (2007) Nise John Wiley & Sons
Reference Books	
1	Control system 4th Edition (2009) Nagrath & Gopal New Age International
2	Modern Control System 12th Edition (2009) Dorf Pearson
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

VI SEMESTER
22ME691 : OE IV : Total Quality Management

Course Outcomes :
Upon successful completion of the course, the students will be able to 1. Develop an understanding on quality management philosophies and frameworks. 2. Develop in-depth knowledge on various tools and techniques of quality management. 3. Evaluate the applications of quality tools and techniques in both manufacturing and service industry 4. Analyze quality management methods and solving problems of organization

Unit:1		**7 Hours**
Principles of Quality Management, Pioneers of TQM, Quality costs, Quality system Customer Orientation, Benchmarking, Re-engineering		
Unit:2		**7 Hours**
Leadership, Organizational Structure, Team Building, Information Systems and Documentation – Quality Auditing, ISO 9000 - QS 9000.QMS, Quality awards.		
Unit:3		**8 Hours**
Single Vendor Concept, J.I.T., Quality Function deployment, Quality Circles, KAIZEN, SGA POKA -YOKE, Taguchi Methods. SMED, Kanban system. Cost of quality. Robust design		
Unit:4		**7 Hours**
Methods and Philosophy of Statistical Process Control, Control Charts for Variables and Attributes		
Unit:5		**8 Hours**
Cumulative sum and exponentially weighted moving average control charts, Others SPC Techniques – Process Capability Analysis. Acceptance Sampling Problem, Single Sampling Plans for attributes, double, multiple and sequential sampling,		
Unit :6		**8 Hours**
Six sigma manufacturing concepts. Six-sigma philosophy Quality strategy and policy. Motivation and leadership theories. Continuous vs. breakthrough improvements. Management of change, DMAIC Methodology. Lean manufacturing		
	Total Lecture	**45 Hours**

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Text Books	
1	Total Quality Management for Engineers 1991 Mohamed Zairi Woodhead Publishing Limited 1991
2	Production and Operations management - Total Quality and Responsiveness 1995 Harvid Noori and Russel McGraw-Hill Inc, 1995 3rd Edition
3	Managing for Total Quality 1998 N.Logothetis Prentice Hall of India Pvt .Ltd,1998
Reference Books	
1	The Essence of Total Quality Management 1995 John Bank Prentice Hall of India Pvt. Ltd., 1995.
2	Introduction to Statistical Quality Control 1991 Douglus C. Montgomery2nd Edition, John Wiley and Sons, 1991.
3	Statistical Quality Control 1984 Grant E.L and Leavensworth McGraw-Hill, 1984.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	

VI SEMESTER
22ME692 : OE IV : Reliability Engineering

Course Outcomes :
Students will be able to: 1. Interpret Reliability, Maintainability, and Availability of engineering systems. 2. Apply Reliability Modeling as a tool for evaluating system performance. 3. Analyze the failure of a machine and the failure rate of systems or components 4. Create production & maintenance schedules of particular engineering systems using various tools used for failure data analysis.

Unit I: Fundamental concepts	**(8 Hrs.)**
Reliability definitions, failure, Failure density, Failure Rate, Hazard Rate, Mean Time To Failure, MTBF, maintainability, availability, safety and reliability, Quality, cost and system effectiveness, Life characteristic phases, modes of failure, Quality and reliability assurance rules, product liability, Importance of Reliability,	
Unit II: Probability theory:-	**(7 Hrs.)**
Set theory, laws of probability, total probability theorem, probability distributions, parameters and applications.	
Unit III: System reliability and modelling:	**(7 Hrs.)**
Series and parallel components, mixed configuration, complex systems. Redundancy, element redundancy, unit redundancy, standby redundancy. Types of standby redundancy, parallel components. Markov models for reliability estimation.	
Unit IV: Maintainability and Availability:	**(8 Hrs.)**
Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system downtime. Availability - Inherent, Achieved, and Operational availability, reliability, and maintainability trade-off. Markov models for availability estimation.	
Unit V: System Reliability Analysis:	**(7 Hrs.)**
Reliability allocation or apportionment. Reliability apportionment techniques. Reliability block diagrams and models. Reliability predictions. Life testing and accelerated testing.	
Unit VI: Strength-based reliability:	**(8Hrs.)**
Safety factor, safety margin, Stress strength interaction, Failure Mode, Effects and Criticality Analysis-, , FMECA examples, Ishikawa diagram .fault tree construction, basic symbols development of functional reliability block diagram, Fault tree analysis, fault tree evaluation techniques, Design of Mechanical components and systems:-Material strengths and loads.	
Total Lecture	**45 Hours**

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Text Books	
1	Concepts of Reliability Engg 1985 L.S. Srinath Affiliated East-Wast Press (P) Ltd
2	Reliability Engineering 1983 A.K. Govil Tata McGraw-Hill Publishing Co. Ltd
3	Reliability Engineering 1984 E. Balagurusmy Tata McGraw-Hill Publishing Co. Ltd
Reference Books	
1	Engineering Reliability 1980 B.S. Dhillion, C. Singh John Wiley & Sons
2	Probabilistic, Reliability 1968 M.L. Shooman McGraw-Hill Book Co.,
3	Reliability in Engineering Design 1977 K.C. Kapur, L.R. Lamberson John-Wiley and sons.

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	

VI SEMESTER
22ME693 : OE IV : Power Generation Engineering

Course Outcomes:
Students will be able to: 1. Analyze and compare the various Thermal power plants. 2. Analyze the hydroelectric and nuclear power plant 3. Evaluate and compare the economics of various power plants. 4. Interpret the non-conventional and combined operations of different power plants.

Unit:1 THERMAL POWER PLANT- I	**8 Hours**
Introduction to thermal power plants and power plant layouts. Site selection. Fuel characteristics, handling, storage, preparation & firing methods. Ash & dust collection and handling. • Boiler: classification, general arrangement, details of different components and system like draught system, steam turbine systems, condenser, cooling towers	
Unit:2 THERMAL POWER PLANT- II	**7 Hours**
Gas Turbine Power Plant: -Introduction, power plant layouts, Open cycle, close cycle power plants. Various components and systems. Methods to improve efficiency. Reheat and Regeneration cycle and their combinations Diesel Electric Power Plant: - Introduction, Outline, type of engines, different components, performance, plant layout. Comparison with other power plant. (visit to nearby power plant shall be arrange for the students)	
Unit:3 HYDROELECTRIC POWER PLANT.	**8 Hours**
Hydrology: - Rainfall, Runoff, Hydro graph, flow duration curve, mass curve. Hydroelectric power plant: - Site selection, classification of hydroelectric power plant, general arrangement, details of different components, turbine selection. Governing. • Comparison with other power plant.	
Unit:4 POWER PLANT ECONOMICS	**7 Hours**
Load Analysis - Fluctuating Load on power plants, Load curves, various terms & definition, peak load, effect of fluctuating load. • Economic Analysis: - Cost of electric energy	
Unit:5 NUCLEAR POWER PLANT	**8Hours**
ion to Nuclear Engineering, Global scenario, prominent installations worldwide, present & proposed nuclear plant in India. Nuclear Reactors: - Types of reactors, PWR, BWR, CANDU, Gas cooled, liquid metal cooled, Breeder reactor. Operational requirements and difficulties, site selection for location of a nuclear power station Nuclear Waste Disposal. • Comparison with other power plant.	

Unit :6 COMBINED OPERATION OF DIFFERENT POWER PLANTS	7 Hours
Combined operation: - Need division, combination of different plant & their coordination, advantages. **NON-CONVENTIONAL POWER GENERATION SYSTEMS** Introduction to Non-Conventional power Generation Systems • Geo-Thermal Power Plant, Tidal Power Plant, Wind Power Plant, Solar Power Plant.	
Total Lecture Hours	**45 Hours**

	Text books
1	"Power Plant Engineering" by A.K. Raja, Amit Prakash Srivastava, and Manish Dwivedi, published in its 1st edition by New Age International Publisher
2	"Power Plant Engineering" by Frederick T. Morse, now in its 3rd edition and published by Van Nostrand Reinhold
3	"Power Plant Engineering" by P.K. Nag, which is currently in its 4th edition and published by McGraw Hill Education
	Reference Books
1	Power Plant Engineering Larry Drbal, Kayla Westra, and Pat Boston 1st Edition Springer
	YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]
1	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/MECHANICAL%20ENGINEERING%20(ER%20Series).pdf
2	http://103.152.199.179/YCCE/Suported%20file/Supprted%20file/SERIES%20WISE%20BOOKS/MECHANICAL%20ENGINEERING/PRODUCTION%20ENGINEERING%20(E%20Series).pdf
	MOOCs Links and additional reading, learning, video material
1	https://youtu.be/8jaIeXu5mzs
2	https://youtu.be/AAeXqnhwPZ4
3	https://www.digimat.in/nptel/courses/video/112106134/L02.html

VI SEMESTER
22ME694 : OE IV : Project Evaluation & Management

Course Outcomes:
Upon successful completion of the course the students will be able to 1. Examine and screen project ideas. 2. Analyze the Technical and Economical feasibility of the project. 3. Design and analyze the project and prepare project report 4. Evaluate the project on Economical, Social and Environmental aspects.

Unit:1	**Project Identification**	**7 Hours**
Project identification considering objectives - B2B, B2C and SWOT analysis, Screening of Project Ideas, Technical, Market, Financial, Socioeconomic and Ecological Appraisal of a project, demand forecasting, secondary data, accuracy, confidence level, uncertainty. **Contemporary Issues related to Topic**		
Unit:2	**Technical feasibility**	**7 Hours**
Technical feasibility- Process selection, Level of automation, Plant capacity, Acquiring technology, Appropriate technology Pla**nt** location, Skill requirement & availability of Manpower- Both white collar & Blue collar, Equipment selection & procurement, Govt. policies, Value analysis and project evaluation. **Contemporary Issues related to Topic**		
Unit:3	**Economic feasibility**	**9 Hours**
Economic feasibility- Cost of Project, working capital analysis, fixed cost, means of finance, estimation of sales & production, price analysis, Break-even point, Projected cash flow statements, projected balance sheet, projected profit & loss statement, projected cash flow, rate of return, Discounted payback period, cost benefit analysis, return after taxes. **Contemporary Issues related to Topic**		
Unit:4	**Project Planning and Control**	**7 Hours**
Project Planning and Contro-: Work break down structure and network development, Basic Scheduling, Critical Path and four kinds of floats, Scheduling under probabilistic durations, Time Cost tradeoffs, CPM, PERT, Optimum project duration, resource allocation, updating. **Contemporary Issues related to Topic**		
Unit:5	**Project report**	**7 Hours**
Project report- Preparation of project report, Project safety management, risk analysis, sensitivity analysis, methods of raising capital **Contemporary Issues related to Topic**		

Unit:6	Project review	8 Hours
Initial review, pre commissioning safety review, performance analysis, ratio analysis, sickness, project revival, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion environmental & social aspects. **Contemporary Issues related to Topic**		
	Total Lecture Hours	**45 Hours**

Text books	
1	Prasanna Chandra, Projects, 9th Edition, McGraw Hill Education (India) Private Limited, 2019
Reference Books	
1	L. S. Srinath, PERT and CPM-Principles and Application, 3rd Edition, East West publisher, 2001
2	M. Y. Khan and P. K. Jain, Financial Management, Tata McGraw Hill Education Private Limited, 6th edition, 2011
3	R. Panneerselvam, Engineering Economics, PHI Learning Private Limited, New Delhi,2nd edition, 2014
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	
2	
MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/110107081
2	https://nptel.ac.in/courses/110104073

VI SEMESTER
22ME604 : PROJECT PHASE-1

COURSE OUTCOME
On successful completion of the course students will be able to: • Demonstrate a sound technical knowledge of their selected project topic. • Undertake problem identification, formulation and solution. • Design engineering solutions to complex problems utilizing a systems approach including ability to work in a team. • Communicate effectively to discuss and solve engineering problems.

The group of students will continue to work for the project allotted previously and will submit a project report based on their studies. Evaluation will be done continuously and viva voce conducted at the end of the semester.

Audit Course
VI SEMESTER
MLC2126: YCAP6

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A++' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Bachelor of Technology

SoE & Syllabus 2022

7 & 8 Semester

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

June 2022

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No.
22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
SEVENTH SEMESTER															
1	7	PC	ME/ME	22ME701	Automation In Production	**T**	3	0	0	3	3	30	20	50	3 Hrs
2	7	PC	ME/ME	22ME702	**Lab:-** Automation In Production	**P**	0	0	2	2	1		60	40	
5	7	PE	ME/ME		**Professional Elective IV**	**T**	3	0	0	3	3	30	20	50	3 Hrs
3	7	PE	ME/ME		**Professional Elective IV-LAB**	**P**	0	0	2	2	1		60	40	
4	7	PE	ME/ME		**Professional Elective V**	**T**	3	0	0	3	3	30	20	50	3 Hrs
6	7	PE	ME/ME		**Professional Elective VI**	**T**	3	0	0	3	3	30	20	50	3 Hrs
7	7	PE	ME/ME		**Professional Elective VII**	**T**	3	0	0	3	3	30	20	50	3 Hrs
8	7	PR	ME/ME	22ME703	Project Phase-II	**P**	0	0	0	10	5		60	40	
9	7	STR	ME/ME	22ME704	Campus Recrutment Training (CRT)	**P**	0	0	0	0	2		100		
					TOTAL SIXTH SEM		**15**	**0**	**4**	**29**	**24**				

List of Professional Electives- IV, V, VI & VII

Professional Electives-IV

1	7	PE-IV	ME	22ME711	PE IV : CFD
2	7	PE-IV	ME	22ME712	PE IV : **Lab**:- CFD
3	7	PE-IV	ME	22ME713	PE IV : Referigeration Air conditioning and Cryogenics
4	7	PE-IV	ME	22ME714	PE IV : **Lab**:- Referigeration Air conditioning and Cryogenics
5	7	PE-IV	ME	22ME715	PE IV : Vehicle Engineering
6	7	PE-IV	ME	22ME716	PE IV : **Lab**:- Vehicle Engineering
7	7	PE-IV	ME	22ME717	PE IV : Solar Energy and It'S Utilisation
8	7	PE-IV	ME	22ME718	PE IV : **Lab**:- Solar Energy and It'S Utilisation
9	7	PE-IV	ME	22ME719	PE IV : CNC & Robotics
10	7	PE-IV	ME	22ME720	PE IV : **Lab**:- CNC & Robotics
11	7	PE-IV	ME	22ME721	PE IV : Electric and Hybrid Vehicle
12	7	PE-IV	ME	22ME722	PE IV : **Lab**:- Electric and Hybrid Vehicle
13	7	PE-IV	ME	22ME723	PE IV : Earth Moving Equipments
14	7	PE-IV	ME	22ME724	PE IV : **Lab**:- Earth Moving Equipments

Professional Electives-V

1	7	PE-V	ME	22ME731	PE V : Machine Learning in Manufacturing
2	7	PE-V	ME	22ME732	PE V : Project Evaluation & Management
3	7	PE-V	ME	22ME733	PE V: Thermal Engineering Systems
4	7	PE-V	ME	22ME734	PE V : Surface Engineering
5	7	PE-V	ME	22ME735	PE V : Synthesis of Mechanism
6	7	PE-V	ME	22ME736	PE V : Turbines
7	7	PE-V	ME	22ME737	PE V : Control System Engineering
8	7	PE-V	ME	22ME738	PE V: Machine Tool Design

Professional Electives-VI

1	7	PE-VI	ME	22ME751	PE VI: Stress Analysis
2	7	PE-VI	ME	22ME752	PE VI : Product Design and Development
3	7	PE-VI	ME	22ME753	PE VI : Power Plant Engineering
4	7	PE-VI	ME	22ME754	PE VI : IOT in ME
5	7	PE-VI	ME	22ME755	PE VI : Design of Experiments and Taguchi Methods
6	7	PE-VI	ME	22ME756	PE VI : Non Destructive testing
7	7	PE-VI	ME	22ME757	PE VI: Computetional Methods in ME

Professional Electives-VII

1	7	PE-VII	ME	22ME771	PE VII: Engineering failure Analysis
2	7	PE-VII	ME	22ME772	PE VII: Vibration
3	7	PE-VII	ME	22ME773	PE VII: Gas Dynamics and Jet Propulsion
4	7	PE-VII	ME	22ME774	PE VII: Industry 4.0
5	7	PE-VII	ME	22ME775	PE VII: MEMS
6	7	PE-VII	ME	22ME776	PE VII: AI in Manufacturing
7	7	PE-VII	ME	22ME777	PE VII : Lean Manufacturing and Six Sigma

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA = for Practical : MSPA will be 15 marks each**

		June 2022	**1.00**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for AY 2022-23 Onwards

Nagar Yuwak Shikshan Sanstha's

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SoE No.
22ME-101

B.TECH SCHEME OF EXAMINATION 2022

(Scheme of Examination w.e.f. 2022-23 onward)

(Department of Mechanical Engineering)

B. Tech in Mechanical Engineering

SN	Sem	Type	BoS/ Deptt	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
							L	T	P	Hrs		MSEs*	TA**	ESE	
Eighth Semester															
1	**8**	**STR**	ME	22ME801	Industrial Internship	**P**	0	0	12	12	3		60	40	
2	**8**	**STR**	ME	22ME802	Extra Curricular Activity Evaluation	**P**	0	0	0	0	2		100		
					TOTAL EIGHTH SEM		**0**	**0**	**12**	**12**	**5**				
					GRAND TOTAL		**127**	**4**	**58**	**197**	**166**				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities
TA = for Practical : MSPA will be 15 marks each**

		June 2022	**1.00**	**Applicable for AY 2022-23 Onwards**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**	

VII SEMESTER

22ME701 : Automation in Production

ME	Automation In Production			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Design and evaluate a balanced line for production and assembly system.
- Create the CNC manual and APT part programs for simple and complex geometries for various machining operations.
- Recognize the application of industrial robotics subjected to automated material handling in automated production system.
- Apply the concepts of CAQC,CAPP and GT to the development of FMS.

Unit I: **(8 Hrs.)**

Automation- Definition, types, reasons for automating, arguments for and against automation. Types of production, functions in manufacturing, Automated Flow 'Lines - Buffer storage. Analysis of flow lines- General terminology and analysis, analysis of transfer lines without storage, partial automation, and automated flow lines with storage buffers, manual assembly lines. Line Balancing Problem, Methods of line balancing. Automated Assembly Systems- Types, parts delivery system ,Throughput analysis for line balancing , Introduction to Simulation software's ,SIMUL8,WITNESS for line balancing and case studies on line balancing.

Unit II: **(9 Hrs.)**

Numerical Control Production Systems- Basic concepts coordinate system and machine motion- Types of NC systems- Point to point, straight cut and continuous path. Machine control unit and other components, Tape and tape readers.

NC part programming- word address format, methods of part programming, Computer numerical control ,manual part programming: APT programming, Direct numerical control.. Adaptive control. Applications of CNC. CAM software's, Integration of CNC machines with robots.

Unit III: **(7 Hrs.)**

Industrial Robotics- Introduction, robot anatomy, robot control systems, accuracy and repeatability and other specifications, end effectors, sensors, introduction to robot programming, Robot applications- Characteristics of robot applications, work cell layout, robot applications in material handling, processing, assembly and inspection. Introduction of DH notations, Robot simulation softwares.

Unit IV: **(7 Hrs.)**

Automated material handling & storage-Conveyor systems: Automated Guided Vehicle Systems - Types: - Driverless trains, AGVS pallet trucks, AGVS unit-load carriers. Vehicle guidance & Routing, Traffic control & safety, System management, Analysis of AGVS systems, AGVS applications. AGVS industrial case studies

Automated Storage & Retrieval System -

Types :- Unit load AS/RS , mini load AS/RS , man on board AS/RS , automated item retrieval system, deep lane AS/RS -Basic components & special features of AS/RS , Carousel storage systems , Work in process storage, quantitative analysis. AS/RS industrial case studies.

Unit V: **(8 Hrs.)**

Automated inspection & Group technology:- Automated inspection principles & methods -100% automated inspection, off -line & on -line inspection, distributed inspection & final inspection; Sensor technologies for automated inspection , coordinate measuring machines -constructional , operation & benefits; Machine vision -image acquisition & digitization, image processing & analysis, interpretation, machine vision applications; Other optical inspection methods -Scanning laser systems , linear allay devices, optical triangulation techniques. Introduction to Group Technology. GT classification ,GT Coding system ,PFA ,GT interface for FMS ,GT industrial applications case studies.

Unit VI: **(7 Hrs.)**

Computer aided manufacturing:-Manufacturing planning, manufacturing control ; Computer integrated manufacturing .Flexible manufacturing systems -Components, Types of systems, FMS layout configuration computer functions, data files, system reports, FMS benefits. Designing FMS system, Case studies of FMS. Computer aided process planning: Retrieval CAPP systems, generative CAPP systems, benefits of CAPP. Shop floor control. Industrial case studies and CAPP software.

Total Lecture **45 Hours**

Text books:

S.N.	Title of the book	Edition (Year of publication)	Author(s)	Publisher
1	Automation, production System & CIMS	Third edition (2016)	M P, Groover PHI	Prentice Hall
2	CAD/CAM	Fifth edition (2018)	Zimmers & Groover PIll	Pearson Education India

Reference Books:

1	Numerical Control And Computer Aided Manufacturing	13th edition (2017)	Rao, N K Tiwari, T K Kundra	Tata McGraw-Hill Education
2	Computer Control of Manufacturing Systems.	20015	Koren	Mcgraw Hill

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://classroom.google.com/u/1/c/NDk3MzQ3NDgxNjk0/m/NTA3NTE0MDczODgz/details
2	https://classroom.google.com/u/1/c/NTg5NTUzODA0NDE4
3	

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc21_mg92/preview
2.	https://dl.acm.org/doi/10.5555/1537195
3.	https://link.springer.com/book/10.1007/978-981-19-9338-1?page=2

Fractography and Failure Analysis" by John J. G. Fatigue, T. R. Shives, and Colin Gagg

VII SEMESTER
22ME702 : Automation in Production Lab

ME	Lab: - Automation in Production			L=0	T=0	P=2	CREDITS = 1
		EVALUATION SCHEME					
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION	
15	15	15	15	40	100	--	

Course Outcomes:
(I) Designing, experimentation and evaluation of CNC programs.
(II)Designing and justifying robot programming for industrial applications.
(III)Transform manual GT cell to build FMS.
(IV)Evaluate and justify use of automated material handling and inspection for building automated industries.

Minimum Ten Practical's to be performed from the list below

Practicals
1) Practice Programming on Manual Part Program ,Drilling ,Milling
2) Performance, Simulation on CNC milling with Siemens 828D controller (at least two Complex Geometries)
3) Performance, Simulation on lathe with Siemens 828D controller (at- least two Complex Geometric)
4) Practice Programming on APT
5) Case Study on Automated System of any Industry.
6) Performance/ Practical on Robot. Robot programming using Teach pendant
7) Forward and Inverse kinematics using Simulation softwares
8) Part Coding and Group Technology case studies
9) Study of FMS industrial case studies
10) Study of Automated material handling ,AGVS ,AS/RS with industrial case studies
11) Study of Automated inspection with latest industrial case studies

VII SEMESTER

22ME711 : PE-IV: Computational Fluid Dynamics

ME	PE-IV: Computational Fluid Dynamics			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Student will be able to develop an understanding for the major theories, approaches and methodologies used in CFD.
- Student will be able to build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes.
- Student will be able to gain experience in the application of CFD analysis to real engineering designs.
- Student will be able to understand the elimination of numerical errors (verification), modeling errors (validation), and uncertainties for CFD.

Unit I: Equations of fluid dynamics	**(8 Hrs.)**
Basic concepts Eulerarian and Lagrangian methods of describing fluid flow motion, acceleration and deformation of fluid particle, vorticity, Laws governing fluid motion, continuity, Navier – stokes & energy equations. Boundary layer equation, Euler equations, potential flow equations, Bernoulli's equation and vorticity transport equation. Initial and boundary conditions. Classification of equation of motions – hyperbolic, parabolic, elliptic.	
Unit II: Mathematical Preliminaries	**(7 Hrs.)**
Numerical integration. Review of linear algebra, solution of simultaneous linear algebraic equations – matrix inversion, solvers – direct methods, elimination methods, ill conditioned systems, Gauss- Seidel method, successive over relaxation method.	
Unit III: Grid Generation	**(8 Hrs.)**
General principles of grid generation – structured grid's in two and three dimensions, differential equations based grid generation; Elliptic grid generation, algorithm, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation.	
Unit IV: Finite Difference Discretisation - I	**(7 Hrs.)**
Elementary finite difference coefficients, basic aspects of finite difference equations, steady and unsteady state heat conduction with FDM approach, consistency, explicit and implicit methods, errors and stability analysis. Stability of elliptic and hyperbolic equations.	
Unit V: Finite Difference Discretisation - II	**(8 Hrs.)**
Fundamentals of fluid flow modelling-conservative property, upwind scheme, transporting property, higher order upwinding. Finite difference applications in heat transfer – conduction, convection.	
Unit VI: Finite Volume Method	**(7Hrs.)**
Introduction, Application of FVM in diffusion and convection problems, steady and unsteady state heat conduction with FDM approach, NS equations – staggered grid, SIMPLE algorithm. Solution of discretised equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes.	
Total Lecture	**45 Hours**

Textbooks:	
1.	Anderson John D., Computational Fluid Dynamics, Mc-Graw Hill Corp., 1995

Reference Books:	
1.	Versteeg, H. K. and Malalasekara, W., Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd Edition, (Indian Reprint) Pearson Education.
2.	Patankar S V, Numerical Heat Transfer and Fluid Flow, Mc-Graw Hill Corp., 1962.
3.	Ferziger J. H. and Springer P. M., Computational Methods for Fluid Dynamics, Verlag Berling.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://ftp.demec.ufpr.br/disciplinas/TM702/Versteeg_Malalasekera_2ed.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112105045

VII SEMESTER

22ME711 : Lab.: PE-IV: Computational Fluid Dynamics Lab

ME	PE-IV: Computational Fluid Dynamics Lab			L=0	T=0	P=2	CREDITS = 1
		EVALUATION SCHEME					
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION	
15	15	15	15	40	100	--	

Course Outcomes

Upon successful completion of the course the students will be able to

- Student will be able to develop an understanding for the major theories, approaches and methodologies used in CFD.
- Student will be able to build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes.
- Student will be able to gain experience in the application of CFD analysis to real engineering designs.
- Student will be able to understand the elimination of numerical errors (verification), modeling errors (validation), and uncertainties for CFD.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Introduction of ANSYS software
2	Domain modelling
3	Mesh Generation and Refinement
4	Steady state heat transfer problem (2D)
5	Transient heat transfer problem (2D)
6	Steady state heat transfer problem (3D)
7	Transient heat transfer problem (3D)
8	Fluid flow problem 1 (2D)
9	Fluid flow problem 2 (2D)
10	Fluid flow problem 1 (3D)
11	Fluid flow problem 2 (3D)
12	Radiation heat Transfer Problem

VII SEMESTER

22ME713 : PE-IV: Refrigeration Air conditioning and Cryogenics

ME	PE-IV: Refrigeration Air conditioning and Cryogenics			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

- The student will be able to describe, analyze and evaluate Vapour Compression Refrigeration System.
- The student will be able to describe and analyze other refrigeration system such as Vapour Absorption Refrigeration System, Electrolux refrigeration system, steam jet refrigeration systems, thermoelectric refrigeration and vortex tube refrigeration
- The student will be able to describe, analyze and evaluate Air Cycle Refrigeration Systems.
- The student will be able to describe and analyze Cryogenic Systems.

Unit I: Air refrigeration systems **(8 Hrs.)**

Gas cycle refrigeration, reversed Brayton /Joules/Bell Coleman cycle, aircraft refrigeration, simple cycle, boot strap cycle, reduced ambient air cycle, regenerative cycle

Unit II: Vapor Compression Refrigeration system **(7 Hrs.)**

Introduction to refrigeration, applications of refrigeration, development of simple saturated Vapour compression refrigeration cycle, effect of change in evaporator and condenser pressure, effect of pressure drops, polytropic compression, sub cooling, superheating.

Unit III: Multistage Refrigeration systems **(8 Hrs.)**

Working and analysis of multistage systems multiple evaporator and multiple compressor systems.

Unit IV: Components of Vapour compression system **(7 Hrs.)**

Various components used in refrigeration system like compressors, condensers, evaporators, expansion devices and its types, cooling towers, and various control use in refrigeration system

Refrigerants: Types and classification, properties and nomenclature, environment-friendly refrigerants.

Unit V: Other refrigeration systems **(8 Hrs.)**

Vapor absorption systems (NH3- H20, LiBr- H2O) , Electrolux refrigeration system, Steam jet refrigeration systems, Thermoelectric refrigeration, Vortex tube refrigeration.

Unit VI: Cryogenics **(7Hrs.)**

Introduction and applications of cryogenics, Cascade refrigeration, Joules Thomson effect, methods of air liquefaction, Linde's and Claude's cycle .Liquefaction of hydrogen, Liquefaction of helium, cryogenic insulation. Hazards and safety, production of dry ice.

Total Lecture **45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	Dossat Roy J.; Principles of Refrigeration, 4th Ed.; Pearson Education Asia Publication
2	Arora C.P.; Refrigeration and Air conditioning, 2nd Ed.; Tata Mc Graw Hill Publication

Reference Books:	
1.	Prasad Manohar; Refrigeration and Air conditioning, 2nd Ed.; New edge Publication
2.	Patankar S V, Numerical Heat Transfer and Fluid Flow, Mc-Graw Hill Corp., 1962.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://ftp.demec.ufpr.br/disciplinas/TM702/Versteeg_Malalasekera_2ed.pdf

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112105045

VII SEMESTER

22ME714 : Lab.: PE-IV: Refrigeration Air conditioning and Cryogenics Lab

ME	PE-IV: Refrigeration Air conditioning and Cryogenics Lab	L=0	T=0	P=2	CREDITS = 1

EVALUATION SCHEME						
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION
15	15	15	15	40	100	--

Course Outcomes

Upon successful completion of the course the students will be able to

- The student will be able to describe, analyze and evaluate Vapour Compression Refrigeration System.
- The student will be able to describe and analyze other refrigeration system such as Vapour Absorption Refrigeration System, Electrolux refrigeration system, steam jet refrigeration systems, thermoelectric refrigeration and vortex tube refrigeration
- The student will be able to describe, analyze and evaluate Air Cycle Refrigeration Systems.
- The student will be able to describe and analyze Cryogenic Systems

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Experiment on Determination of COP of Refrigeration trainer
2	Trial on ice-plant test rig
3	Study of expansion devices used in vapour compression refrigeration system
4	Study of condensers and cooling towers used in vapour compression refrigeration system
5	Study of Evaporators used in vapour compression refrigeration system
6	Study of vapour absorption refrigeration system
7	Study of Electrolux refrigeration system
8	Study of controls used in refrigeration system
9	Visit to air liquefaction plant

10	Visit to cold storage
11	Visit to Industrial cooling tower
12	Visit to ice plant

VII SEMESTER
22ME715 : PE-IV: Vehicle Engineering

ME	PE-IV: Vehicle Engineering			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

1. Student will be able to Classify & Explain various systems of Engine, its function including fuel supply, cooling and lubrication system in vehicle.
2. Student will be able to Analyze and Explain various power transmission systems from clutch to wheel in vehicle.
3. Student will be able to Student will be able to Classify and Compare control systems like steering, suspension and brakes in vehicle.
4. Student will be able to Explain and Recommend the necessary electrical and luxurious systems and safety system in vehicle. (

Unit I: Power Plant **(8 Hrs.)**

Introduction, classification, history & development of Automobiles. Vehicles layout, Various engine systems and components, construction & working of I.C. engines.
Introduction to Fuel supply system: for Petrol and Diesel Engine, CRDI, GDI, EFI, MPFI, Engine fuels: Gasoline, diesel, bio-diesel, CNG.
Engine cooling and lubrication systems.
Contemporary Issues related to Topic : Power system : electrical, hybrids, solar, wind, compressed air, fuel cell, hydrogen etc.

Unit II: Transmission **(8 Hrs.)**

Clutch: Necessity, requirements & Types of a clutch
Gear box: Classification, Necessity & working principle of gear box, Propeller shaft, Slip & Universal joints.
Differential: Need and working, Differential lock, Rear Axles and Front Axles.
Contemporary Issues related to Topic: Introduction to Automatic Transmission: Fully and Semi-automatic.

Unit III: Steering, Suspension & Brakes **(8 Hrs.)**

Steering systems: principle of steering, steering linkages, steering geometry and wheel alignment, steering gear box and its types.
Suspension systems: Function, conventional and Independent suspension System, shock absorber.
Brakes: Drum and Disc brakes, Comparison, Mechanical, hydraulic, Air brakes.
Contemporary Issues related to Topic: Power steering

Unit IV: Wheels & vehicle dynamics **(7 Hrs.)**

Wheel and Tyres: Construction & classification of wheels & Tyres, tyre specification, factors affecting tyre performance.
Resistance to vehicle motion: Air, Road and gradient resistance and power calculation, Low and high speed turning, tyre cornering forces, Vehicle aerodynamics and its necessity.

Contemporary Issues related to Topic: Race car aerodynamics	
Unit V: Electrical systems	**(7Hrs.)**
Electrical systems: Battery construction. Specification. Operation of Batteries. Charging of battery, Alternator, Starting system, Battery Ignition and magneto ignition systems, Lighting, Horn, Side indicator, wiper, and other electrical systems, Automobile air-conditioning, Panel Board instruments. **Contemporary Issues related to Topic:** Introduction to EV's	
Unit VI: Maintenance & Safety	**(7Hrs.)**
Engine overhauling, Engine tune up, Tyre rotation & balancing, Fault detection techniques and remedies. Collision avoidance system and vehicle to vehicle communication, Airbags system, EBD, ABS and other safety features, cruise control. **Contemporary Issues related to Topic:** Navigation system and control.	
Total Lecture	**45 Hours**

Textbooks:	
1.	Singh Kirpal, Automobile Engineering, Volume 1 & 2, Standard publishers and distributers, 14th Edition, 2021

Reference Books:	
1.	Ganesan V, Internal Combustion Engines, 4th Edition, McGraw Hill Education, 2012.
2.	Rajpoot R K, A text book of Automobile Engineering, Laxmi publications (P) Ltd., 1st Edition, 2007.
3.	Sethi H M, Automotive Technology, McGraw-Hill Education, 1991

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/107/106/107106088/

VII SEMESTER

22ME716 : Lab.: PE-IV: Vehicle Engineering Lab

ME	PE-IV: Vehicle Engineering Lab	L=0	T=0	P=2	CREDITS = 1

EVALUATION SCHEME						
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION
15	15	15	15	40	100	--

Course Outcomes

Upon successful completion of the course the students will be able to

1. Student will be able to Classify & Explain various systems of Engine, its function including fuel supply, cooling and lubrication system in vehicle.
2. Student will be able to Analyze and Explain various power transmission systems from clutch to wheel in vehicle.
3. Student will be able to Student will be able to Classify and Compare control systems like steering, suspension and brakes in vehicle.
4. Student will be able to Explain and Recommend the necessary electrical and luxurious systems and safety system in vehicle.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Study of carburettors and fuel injection system.
2	Demonstration to understand various engine components and working of 2S & 4S Engine.
3	Demonstration to understand working of single plate/Multiplayer/Diaphragm automobile clutch.
4	Demonstration of synchromesh gearbox with gear shifting mechanism.
5	Demonstration of final drive and differential.
6	Demonstration of working Hydraulic braking system and comparison with other braking system.
7	Demonstration to understand front wheel steering geometry and steering mechanism.
8	Demonstration to understand suspension system and working of shock absorber.
9	Demonstration of various components of battery and working of its charging system.
10	Demonstration to understand working principle of Electric horn, Brake light and side indicator.
11	Visit to workshop to understand wheel balancing.
12	Visit to servicing station for vehicle maintenance, repairs and report.

VII SEMESTER
22ME717 : PE-IV: Solar Energy & It's Utilization

ME	PE-IV: Solar Energy & It's Utilization			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- **Summarize** the advantages and limitations of solar energy compared to other renewable energy sources..
- **Implement** a basic solar energy project, including site selection and system sizing.
- **Compare** different solar energy technologies in terms of cost, efficiency, and feasibility.
- **Develop** innovative solutions to improve the efficiency and integration of solar energy systems.

Unit I: Basics of solar energy **(8 Hrs.)**

Brief History of solar energy &utilization, Various approaches of utilizing solar energy, Blackbody radiation, Relation between radiation field energy density and radiation spectrum, Planck's formula in energy unit, Maximum spectral density, Planck's formula in wavelength unit, Wien displacement law, Stefan - Boltzmann law, Photoelectric effect, Einstein's theory of photons, Einstein's derivation of the black-body formula.

Unit II: Solar radiation, measurement and estimation **(8 Hrs.)**

History of solar energy utilization, basic definitions, Solar radiation and modeling, Empirical equations for predicting the availability of solar radiation, Measurement of global, direct and diffuse radiation, Radiation computations on inclined surfaces, Angstrom's turbidity, Solar chart, Standard radiation scale, Measurement of solar radiation, Solar energy measuring instruments, Pyranometer, Pyrheliometer, Sunshine recorder, Estimation of average solar radiation, Ratio of beam and total radiation on tilted surface of that on horizontal surface.

Unit III: Concentration of solar energy **(8 Hrs.)**

Three types of imaging optics: trough or linear collectors, central receiver with heliostats, and parabolic dish concentrator with on -axis tracking, Solar thermal electricity is using Stirling engine or Ranking engine, Solar photovoltaic with concentration.

Unit IV: Solar Thermal systems **(7 Hrs.)**

Liquid Flat, Plate collector, air heater and concentrating collector, Solar pond, Solar distillation, Solar drying. Thermal storage. Solar Passive Architecture Passive heating and cooling of Buildings. Solar Cooking, Distillation, Desalination, Solar Drying, Solar Chimney.

Unit V: Solar cells **(7Hrs.)**

Formation of a PN–junction, Space charge and internal field, Quasi - Fermi levels, The Shockley diode equation, Structure of a solar cell, The solar cell equation, Fill factor and maximum power, Various electron, hole-pair recombination mechanisms, Crystalline silicon solar cells, Thin film solar cells: CIGS, Cite and silicon - Tandem solar cells, Dye - sensitized solar cells, Organic solar cells. Photovoltaic applications: battery charger, domestic

lighting, street lighting, water pumping etc., solar PV power plant, Net metering concept.	
Unit VI: Storage of solar energy	**(7 Hrs.)**
Types of Energy Storage, Thermal Storage, Simple water and rock bed storage, pressurized water storage system, Electrical Storage, Fundamental concept of batteries, measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries, Chemical Storage, Fuel Cell, History of Fuel cell, Principles of Electrochemical storage, Types, Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis, advantage and drawback of each type, hydro-storage..	
Total Lecture	**45 Hours**

Textbooks:

S.N.	Title of the book	Edition (Year of publication)	Author(s)	Publisher
1.	Solar Energy Utilization	2010	Rai, G.D.	Khanna Publishers, N. Delhi
2.	Solar Energy	3rd Edition, 2008	Sukhatme S.P.,	Tata McGraw Hills P Co.
3.	Solar Energy Thermal Process	2007	Duffie, J.A., and Beckman	John Wiley and Sons, NewYork,
Reference books:				
1	The Physics of Solar Cells	2003	Nelson	Imperial College Press
2.	Solar Energy: Principles of Thermal Collection and Storage	3rd Edition, 2008	S Sukhatme and J Nayak	Tata McGraw Hill,

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186

MOOCs Links and additional reading, learning, video material	
1.	https://archive.nptel.ac.in/courses/107/106/107106088/

VII SEMESTER

22ME718 : Lab.: PE-IV: Solar Energy & It's Utilization Lab

ME	PE-IV: Solar Energy & It's Utilization Lab	L=0	T=0	P=2	CREDITS = 1

EVALUATION SCHEME						
MSPA – I	**MSPA –II**	**MSPA – III**	**MSPA – IV**	**ESE**	**TOTAL**	**ESE DURATION**
15	15	15	15	40	100	--

Course Outcomes

Upon successful completion of the course the students will be able to

- **Summarize** the advantages and limitations of solar energy compared to other renewable energy sources..
- **Implement** a basic solar energy project, including site selection and system sizing.
- **Compare** different solar energy technologies in terms of cost, efficiency, and feasibility.
- **Develop** innovative solutions to improve the efficiency and integration of solar energy systems.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Solar Radiation Measurements
2	Flat Plate Solar Water Heater
3	Flat Plate Solar Air Heater
4	Flat Plate Collector with Reflector
5	Parabolic Tube Collector
6	Evacuated Tube Collector
7	Solar Cookers
8	Thermal Storage System
9	Study on Solar Cell Characteristics
10	Testing of SPV Standalone Systems
11	Testing of SPV system with tracking unit
12	Performance Evaluation of SPV

VI SEMESTER
22ME719 : CNC and Robotics

ME	PE-IV: CNC and Robotics			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Understand the principles of components and architecture of computer numerical control (CNC) machines, including their types, basics of tooling and fixtures, application and limitations.
- Develop the programming for CNC drilling, milling and turning operations.
- Understand the basic concepts of industrial robotics, including their types, applications and components.
- Learn the basics of programming industrial robots and analyse the sensors using in industrial robots for various industrial applications.

Unit I: Introduction **(6 Hrs.)**

Concepts of NC, CNC, DNC. Classification of CNC machines, MCU architecture and functionality, Machine Configurations, Types of control, CNC controller's architecture and characteristics, Interpolators, CNC hardware and control systems.

Contemporary Issues related to Topic

Unit II: CNC Programming (Basic) **(7 Hrs.)**

Positioning system, Cutter offset compensation, Word address format, Introduction to G and M codes, Manual part programming for CNC drilling, milling and turning.

Contemporary Issues related to Topic

Unit III: CNC Programming (Advanced) **(7 Hrs.)**

Tooling system for Machining center and Turning center, work holding devices, of CNC Machines. APT part programming, CAD/CAM programming, Simulation and Verification of CNC programs, Adaptive CNC control techniques. Integration of CNC machines for CIM.

Contemporary Issues related to Topic

Unit IV: Basics of Robot **(7 Hrs.)**

Introduction to Robot and Robotics- Definition and types, Need for robots, Robot anatomy, Robot configurations, co-ordinate systems, work envelope, Basic robot motions, Specifications - Pitch, yaw, roll, joint notations, speed of motion and pay load, Robot parts and their functions.
End effector- types and classification, Types of drives, Sensors in robot, Machine vision- object recognition and categorisation
Robot applications- (Assembly, inspection, material handling, processing).

Contemporary Issues related to Topic

Unit V: Robot Kinematics and Trajectory Planning	**(6 Hrs.)**

Robot kinematics- Forward kinematics, Inverse kinematics of manipulators- Derivation and problems with two and three degrees of freedom, Introduction to DH notations, Trajectory generation- General consideration in path description and generation, joint space schemes, collision free path planning, Robot programming.
Path motion control in robot- limited sequence control, playback with point to point control, playback with continuous path control and intelligent control.

Contemporary Issues related to Topic

Unit VI: Robot Programming and Implementation	**(6 Hrs.)**

Robot programming- Online (lead through programming) and Offline programming (Textual language programming), Robot programming languages – VAL, RAPID, simple programming commands – Motion commands, Sensor commands, End effecter commands, Robot programs for simple operations- pick and place operation, arc welding, spray painting.
Implementation of robots in industries – Various steps - Safety considerations for robot operations, Integration of Robots with CNC machines for CIM.

Contemporary Issues related to Topic

Total Lecture	**39 Hours**

Textbooks:				
1.	Automation in Production system	2002	Mikell P. Groover	Prentice-Hall of India Pvt. Ltd., New Delhi, 2002
2.	Industrial Robotics: Technology, Programming and Applications, Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta	2012	Mikell P. Groover, Mitchel	2nd Edition, Tata McGraw Hill, 2012.
3.	Robot Engineering An Intergrated approach Springer	2004	Klafter R.D., Chmielewski T.A. and Negin M	
4.	Bruno S and Sciavicco L, Robotics: Modelling, Planning and Control, Springer (2009)			

Reference Books:				
1.	CNC Technology and Programming	2003	Krar, S., and Gill	Industrial Press Inc
2.	An Introduction to CNC Machining	1991	Gibbs, D.	Industrial Press
3.	Computer Numerical Control Concepts and Programming EMEA, Limited	1991	Seames, W.S.	Thomson Learning
4.	Computer Numerical Control for Machining	1993	Lynch, M	McGraw-Hill
5.	Computer Control of Manufacturing Systems	2005	Koren Y	Tata McGraw-Hill Education
6.	Robotics control, sensing, vision, and intelligence Tata McGraw-Hill Education	2004	Fu K.S., Gonzalez R.C., and Lee C.S.G.	
7.	Robotics Technology and Flexible Automation	2001	Deb S.R	Tata McGraw-Hill Education
8.	Introduction to Robotics Mechanics and Control	2008	Craig J.J	Pearson Education India

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1.	https://youtu.be/PN_tGm5Gip4?si=RTcuVPcJgyISG8YS
2.	https://youtu.be/_5r2XR1h1aQ?si=NRSnchXTt53s31qx
3.	https://youtube.com/playlist?list=PLbRMhDVUMngcdUbBySzyzcPiFTYWr4rV_&si=4flE0athMawZVFxx

VI SEMESTER

22ME720 : Lab.: CNC and Robotics lab

ME	PE-IV: CNC and Robotics lab			L=0	T=0	P=2	CREDITS = 1
		EVALUATION SCHEME					
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION	
15	15	15	15	40	100	--	

Course Outcomes

Upon successful completion of the course the students will be able to

- Demonstrate different components, tooling and work holding devices of CNC milling and Lathe machine.
- Write and execute the programming for CNC drilling, milling and turning operations.
- Perform simple jogging operations on five axis FANUC robot.
- Write and execute the programming for simple pick and place operation on five axis FANUC robot.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Review of research article on CNC and Robot
2	Demonstration of Tooling and work holding device of CNC milling and Lathe
3	Demonstration of CNC control panel
4	Performance, Tool offset and work offset setting of CNC milling and Lathe
5	Performance, Simulation on CNC milling (at least two complex geometries of drilling operation)
6	Performance, Simulation on CNC milling (at least two complex geometries of slotting operation)
7	Performance, Simulation on CNC lathe (at least two complex geometries of turning operations)
8	Performance, jogging operation of five axis FANUC robot
9	Performance, programming for simple pick and place operation on five axis FANUC robot
10	Performance/ Practical on Robo Analyzer

VII SEMESTER
22ME721 : PEIV-Electric and Hybrid vehicles

ME	PE-IV: Electric and Hybrid vehicles			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Student will be able to explain the working of electric vehicles and recent trends.
- Student will be able to analyze different power converter topology used for electric vehicle application.
- Student will be able to develop the electric propulsion unit and its control for application of electric vehicles.
- Student will be able to Design converters for battery charging and explain transformer less topology.

Unit I: Electric and Hybrid Electric Vehicles:	**(8 Hrs.)**
Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.	
Unit II: Energy storage for EV and HEV:	**(8 Hrs.)**
Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Hydrogen fuel cell-Connecting cell in series-water management in the PEM fuel cell- Thermal Management of the PEM fuel cell, Super capacitors.	
Unit III: Electric Propulsion:	**(8 Hrs.)**
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.	
Unit IV: Design of Drive system	**(8 Hrs.)**
Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, and design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, and energy storage design.	
Unit V: Power Electronic Converter for Battery Charging:	**(8 Hrs.)**
Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.	
Unit VI: Electrical Accessories & Safety	**(8 Hrs.)**
Lighting, Horn, Side indicator, wiper, and other electrical systems, Automobile air-conditioning, Panel Board instruments. Tyre rotation & balancing, Collision avoidance system and vehicle to vehicle communication,	

Airbags system, EBD, ABS and other safety features, cruise control. Navigation system and control.	
Total Lecture	**48 Hours**

Textbooks:	
1.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S. Gay and Ali Emadi CRC Press 2005

Reference Books:	
1.	Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press 2003
2.	Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles Sheldon S. Williamson Springer 2013
3.	Modern Electric Vehicle Technology C.C. Chan and K.T. Chau Oxford University 2001

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/book/10.1002/0470090707?SeriesKey=10.1002/9781118536186
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781118752555

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/108106170

VII SEMESTER

22ME722 : Lab.: PEIV-Electric and Hybrid Vehicles Lab

ME	PE-IV: Electric and Hybrid Vehicles lab			L=0	T=0	P=2	CREDITS = 1
		EVALUATION SCHEME					
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION	
15	15	15	15	40	100	--	

Course Outcomes

Upon successful completion of the course the students will be able to

- Student will be able to explain the working of electric vehicles and recent trends.
- Student will be able to analyze different power converter topology used for electric vehicle application.
- Student will be able to develop the electric propulsion unit and its control for application of electric vehicles.
- Student will be able to Design converters for battery charging and explain transformer less topology.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Study of different systems of Hybrid and electric vehicles.
2	Study of Speed control of DC motor using IGBT.
3	Demonstration of Wiring layout of Electric Vehicles.
4	Study of Control circuit of an Induction Motor
5	Demonstration of Controllers and Actuators in Electric Vehicles.
6	Demonstration of various components of battery and working of its charging system.
7	Demonstration to understand working principle of Electric horn, Brake light and side indicator.
8	Study of various types of Braking systems.
9	Case study of any Electric/ Hybrid car manufactured/sale in India.
10	Visit to servicing station for electric vehicle maintenance, repairs and report.

VI SEMESTER

22ME723 : PE – IV : EARTH MOVING EQUIPMENT

ME	PE-IV: EARTH MOVING EQUIPMENT			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- **Summarize** the knowledge in Earth Moving Equipments and its Mechanical components.
- **Summarize** the knowledge in basic Hydraulic hardware system components used in Earth Moving Equipments.
- **Summarize** the knowledge in Electrical and Electronic system used in Earth Moving Equipments
- **Analyze** and **Evaluate** the problems in Earth Moving Equipments systems and provide solutions.

Unit I: Introduction **(8 Hrs.)**

Earthmoving equipments: Introduction, Types and applications.
Hydraulic systems: Components, advantages, applications in the field of Earthmoving Equipments.
Seals, sealing materials, selection of seals.
Filters, strainers, sources of contamination of fluid & its control.
Hoses & Pipes: Types, materials, pressure drop in hoses/pipes, valves and fittings. Hydraulic piping connections.
Types of Hydraulic fluid petroleum based, synthetic & water based. Properties of fluids. Selection of fluids, additives, effect of temperature & pressure on hydraulic fluids.

Unit II: Mechanical Systems **(7 Hrs.)**

Super Structure : Cabin:- dashboard , drive controls and hydraulic controls. Boom, arm and related components.
Under Carriage : Transmission system: drive system , hydraulic systems for earthmoving, Turning system . Gear box and related components.
Attachments : Buckets: Backacter, cam shelve, screening adapter, special buckets.
End effectors: Earthwork attachments, drilling and boring attachment, piling attachment, crusher adapters, breakers, jaws, grabbing and loading attachments

Unit III: Hydraulic Systems **(7 Hrs.)**

Pumps: Types, classification, principle of working & constructional details of vane pump, gear pumps, radial & axial plunger pumps, power and efficiency calculations, characteristic Curves, selection of pumps for hydraulic power transmission.

Accumulators & Intensifiers: Types & functions of accumulators & intensifiers, applications, selection	
Unit IV: Hydraulic Systems	**(8 Hrs.)**
Valves: Types & functions of valves, applications, selection **Actuators:** Linear & Rotary actuators. **Hydraulic motors:** Types, vane, gear piston, radial piston. Hydraulic motor performance. **Hydraulic Cylinders:** Types of cylinder & mountings, calculations of piston velocity, thrust under static & dynamic applications. Design consideration for cylinders. **Hydraulic Circuits**: JIC symbols / ISO Symbols for hydraulic circuits Different hydraulic circuits used in Construction equipments. Hydraulic circuit analysis	
Unit V: Electrical and Electronics System	**(7 Hrs.)**
Basic electrical components switches, cables, colour coding of cables, Relays,. The basic connections – series and parallel circuits. Electric circuits of earthmoving equipments.. **Electronics Circuits:** Symbols for Electronics circuits Different Electronics circuits used in earthmoving equipments. Electronics circuit analysis	
Unit VI: Maintenance of Earthmoving Equipments	**(8 Hrs.)**
Preventive, predictive & breakdown maintenance. Trouble shooting & safety precautions. Electronics diagnostic and Computer Aided Diagnostic systems	
Total Lecture	**45 Hours**

Textbooks:	
1.	James L Johnson , Introduction to Fluid Power, Delmar Thomson Learning, 2002
2.	Anthony Esposito, Fluid Power With Applications, PEARSON Prentice Hall, 6TH Edition
3.	J.J. Pipenger & T. G. Hicks, Industrial Hydraulics, McGraw Hill Co., 3RD Edition
4.	S. R. Majumdar, Pneumatic Systems: Principles and Maintenance, Tata McGraw-Hill Education, 2016

Reference Books:	
1.	Michael J. Pinches , Power pneumatics, Prentice Hall,, 2007
2.	Vickers, Vickers manuals on Industrial Hydraulics, Vickers, 1996
3.	Harry L. Stewart, Hydraulics & Pneumatics, Industrial Press, 4TH Edition
4.	Franklin D. Yeaple, Fluid Power Design Handbook, Marcel Dekker, 1996

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MOOCs Links and additional reading, learning, video material	
1.	
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VI SEMESTER

22ME724 : PE – IV : EARTH MOVING EQUIPMENT LAB

ME	PE-IV: EARTH MOVING EQUIPMENT lab			L=0	T=0	P=2	CREDITS = 1
EVALUATION SCHEME							
MSPA – I	MSPA –II	MSPA – III	MSPA – IV	ESE	TOTAL	ESE DURATION	
15	15	15	15	40	100	--	

Course Outcomes

Upon successful completion of the course, the students will be able to;

- **Summarize** the knowledge in Earth Moving Equipments and its Mechanical components.
- **Summarize** the knowledge in basic Hydraulic hardware system components used in Earth Moving Equipments.
- **Summarize** the knowledge in Electrical and Electronic system used in Earth Moving Equipments
- **Analyze** and **Evaluate** the problems in Earth Moving Equipments systems and provide solutions.

Minimum Ten Practical's to be performed from the list below

SN	Experiments based on
1	Types Of Earthmoving Equipments
2	Hoses, Seals & Hydraulic Oils
3	Mechanical Components Of Earthmoving Equipments
4	Study Of Pumps
5	Study Of Valves
6	Hydraulic Cylinders And Circuits
7	Basic Electrical And Electronics System
8	Trouble Shooting And Computer Aided Diagnostic System
9	Industry Visit
10	Industry Visit

VII SEMESTER

22ME731 :PE:V Machine Learning in Manufacturing

ME	PE-V:- Machine Learning in Manufacturing			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

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

1. Understand machine learning's relevance in manufacturing
2. Able to proficiently preprocess data and engineer features
3. Implement supervised and unsupervised algorithms
4. Apply deep learning and reinforcement learning techniques to optimize manufacturing processes.

Unit I: Introduction to Machine Learning in Manufacturing (Difficulty Level: Beginner) (8 Hrs.)

Overview of machine learning and its relevance to manufacturing industries - Historical perspective: evolution of machine learning in manufacturing - Types of machine learning algorithms: supervised, unsupervised, reinforcement learning - Applications of machine learning in manufacturing: predictive maintenance, quality control, process optimization - Challenges and opportunities in implementing machine learning in manufacturing

Case Studies:

1. Predictive maintenance of industrial machinery using supervised learning algorithms
2. Quality control in automotive manufacturing using computer vision techniques

Software: Python with libraries such as Scikit-learn, TensorFlow, or Keras

Unit II: Data Pre-processing and Feature Engineering (Difficulty Level: Intermediate) (8 Hrs.)

Data pre-processing techniques: cleaning, transformation, normalization - Handling missing data and outliers - Feature engineering: feature selection, extraction, and transformation - Dimensionality reduction methods: PCA, t-SNE - Importance of data quality in machine learning models

Case Studies:

1. Preprocessing sensor data for predictive maintenance in CNC machining
2. Feature engineering for anomaly detection in manufacturing processes

Software: Python libraries like Pandas, NumPy, and Scikit-learn

Unit III: Supervised Learning in Manufacturing (Difficulty Level: Intermediate) (7 Hrs.)

Overview of supervised learning algorithms: regression, classification - Linear regression, logistic regression, support vector machines - Decision trees and ensemble methods: random forests, gradient boosting - Model evaluation metrics: accuracy, precision, recall, F1-score, ROC-AUC - Techniques for model selection and hyperparameter tuning

Case Studies:

1. Predicting product defects in semiconductor manufacturing using logistic regression
2. Forecasting demand for inventory optimization using decision trees

Software: Python with Scikit-learn or TensorFlow

Unit IV: Unsupervised Learning in Manufacturing (Difficulty Level: Intermediate)	**(8 Hrs.)**
Clustering algorithms: K-means, hierarchical clustering - Density-based clustering: DBSCAN - Evaluation metrics for clustering algorithms - Dimensionality reduction techniques: PCA, autoencoders - Anomaly detection methods: isolation forests, one-class SVM **Case Studies:** 1. Clustering analysis for process optimization in a chemical manufacturing plant 2. Anomaly detection in industrial equipment using isolation forests Software: Python with Scikit-learn or MATLAB	
Unit V: Deep Learning in Manufacturing (Difficulty Level: Advanced)	**(7 Hrs.)**
Introduction to neural networks and deep learning architectures - Convolutional Neural Networks (CNNs) for image-based manufacturing applications - Recurrent Neural Networks (RNNs) for time-series data analysis - Transfer learning and pre-trained models - Hyperparameter tuning and optimization techniques for deep learning models **Case Studies:** 1. Defect detection in surface inspection using CNNs 2. Time-series forecasting for predictive maintenance using Long Short-Term Memory (LSTM) networks Software: TensorFlow or PyTorch	
Unit VI: Reinforcement Learning for Process Optimization (Difficulty Level: Advanced)	**(7 Hrs.)**
Basics of reinforcement learning: agents, environments, rewards - Markov Decision Processes (MDPs) and Bellman equations - Q-learning and Deep Q-networks (DQN) for process optimization - Policy gradient methods: REINFORCE, actor-critic - Applications of reinforcement learning in manufacturing: scheduling, control, resource allocation **Case Studies:** 1. Autonomous control of robotic assembly using reinforcement learning 2. Optimizing production scheduling using Deep Q-networks – Software: OpenAI Gym with Python	
Total Lecture	**45 Hours**

Textbooks:	
1.	Machine Learning in Manufacturing: Quality 4.0 and the Zero Defects Vision, by Carlos A. Escobar (Author), Ruben Morales-Menendez (Author), Publisher : Elsevier - Health Sciences Division (22 March 2024), Language : English, Paperback : 246 pages, ISBN-10 : 0323990290, ISBN-13 : 978-0323990295
2.	Machine Learning for Sustainable Manufacturing in Industry 4.0: Concept, Concerns and Applications, by Raman Kumar (Editor), Sita Rani (Editor), Sehijpal Singh Khangura (Editor), Publisher : CRC Press; 1st edition (3 November 2023), Language : English, Hardcover : 234 pages, ISBN-10 : 103239305X, ISBN-13:978-1032393056
Reference Books:	
1.	Machine Learning in Industry, Shubhabrata Datta, J. Paulo Davim, Springer Nature, 24 Jul 2021 - Technology & Engineering - 197 pages
2.	Machine Learning in Python for Process Systems Engineering: Achieve Operational Excellence Using Process Data, Ankur Kumar, Jesus Flores-Cerrillo, MLforPSE, 25 Feb 2022 - Computers - 352 pages
3.	Machine Learning and Artificial Intelligence with Industrial Applications: From Big Data to Small Data, Diego Carou, Antonio Sartal, J. Paulo Davim, Springer Nature, 11 Mar 2022 - Technology & Engineering -

	211 pages

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1.	Machine Learning for Engineering and Science Applications By Prof. Balaji Srinivasan and Prof. Ganapathy | IIT Madras https://onlinecourses.nptel.ac.in/noc19_cs82/preview
2.	Introduction to Machine Learning, by Prof. Balaraman Ravindran, IIT Madras https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs24/

VII Semester
22ME732 :PE:V Project Evaluation & Management

ME….	PE V : Project Evaluation & Management			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes:

Upon successful completion of the course the students will be able to

- Examine and screen project ideas.
- Analyze the Technical and Economical feasibility of the project.
- Design and analyze the project and prepare project report
- Evaluate the project on Economical, Social and Environmental aspects.

Unit:1	Project Identification	7 Hours

Project identification considering objectives - B2B, B2C and SWOT analysis, Screening of Project Ideas, Technical, Market,
Financial, Socioeconomic and Ecological Appraisal of a project, demand forecasting, secondary data, accuracy, confidence level, uncertainty.

Contemporary Issues related to Topic

Unit:2	Technical feasibility	8 Hours

Technical feasibility- Process selection, Level of automation, Plant capacity, Acquiring technology, Appropriate technology Pla**nt** location, Skill requirement & availability of Manpower- Both white collar & Blue collar,

Equipment selection & procurement, Govt. policies, Value analysis and project evaluation.

Contemporary Issues related to Topic

Unit:3	Economic feasibility	8 Hours

Economic feasibility- Cost of Project, working capital analysis, fixed cost, means of finance, estimation of sales & production, price analysis, Break-even point, Projected cash flow statements, projected balance sheet, projected
profit & loss statement, projected cash flow, rate of return, Discounted payback period, cost benefit analysis, return after taxes.

Contemporary Issues related to Topic

Unit:4	Project Planning and Control	7 Hours

Project Planning and Contro-: Work break down structure and network development, Basic Scheduling, Critical Path and four kinds of floats, Scheduling under probabilistic durations, Time Cost tradeoffs, CPM, PERT, Optimum project duration, resource allocation, updating. **Contemporary Issues related to Topic**		
Unit:5	**Project report**	**7 Hours**
Project report- Preparation of project report, Project safety management, risk analysis, sensitivity analysis, methods of raising capital **Contemporary Issues related to Topic**		
Unit:6	**Project review**	**8 Hours**
Initial review, pre commissioning safety review, performance analysis, ratio analysis, sickness, project revival, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion environ-mental & social aspects. **Contemporary Issues related to Topic**		
Total Lecture Hours		**45 Hours**

Text books	
1	Prasanna Chandra, Projects, 9th Edition, McGraw Hill Education (India) Private Limited, 2019
Reference Books	
1	L. S. Srinath, PERT and CPM-Principles and Application, 3rd Edition, East West publisher, 2001
2	M. Y. Khan and P. K. Jain, Financial Management, Tata McGraw Hill Education Private Limited, 6th edition, 2011
3	R. Panneerselvam, Engineering Economics, PHI Learning Private Limited, New Delhi,2nd edition, 2014
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/110107081
2	https://nptel.ac.in/courses/110104073

VII SEMESTER
22ME733 : PE:-V Thermal Engineering System

ME….	PE V : Thermal Engineering System			L= 3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
	15	15	20	50	100		3 Hrs

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- describe and analyze the Solar, Wind and Biogas Energy Systems
- describe and analyze the working of Refrigeration system.
- evaluate the Psychrometric properties and describe the air conditioning processes.
- To understand the concept of electric and Hybrid vehicle

Unit I: Solar Energy: **(8 Hrs.)**

Introduction, solar constant, spectral distribution of solar radiation, beam & diffuse radiation, Solar radiation geometry, solar angles. Types of collectors, liquid flat plate collectors, solar air heaters Concentrating collectors, Applications of solar energy to water heating, space heating, space cooling, drying refrigeration, solar cookers, solar thermal electric conversion system, solar photo- voltaic.

Unit II: Wind Energy and Bio Gas **(7 Hrs.)**

Wind Energy: -

Power in wind, forces on blades, wind energy: Basic principle of wind energy conversion, basic components of WECS Classification of WEC systems, savonius and darrieus rotars applications of wind energy

Biogas: -

Introduction, bio gas generation, fixed dome & floating drum biogas plants their constructional details, raw material for biogas production, factors affecting generation of biogas and methods of maintaining biogas, production, fuel properties of biogas and utilisation of biogas

Unit III: Refrigeration **(8 Hrs.)**

Refrigeration: Introduction, unit of refrigeration, Vapour compression refrigeration system. Multi stage vaopur compression system.

Unit IV: Air Conditioning **(7 Hrs.)**

Introduction, psychrometric properties, Evaporative cooling, Bypass factor, Air Conditioning Processes, Typical summer and winter air conditioning system.

Unit V: Electric and Hybrid Vehicle **(8 Hrs.)**

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types.

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,

Unit VI: Energy Auditing **(7 Hrs.)**

Energy Auditing Introduction, Global and Indian Energy Scenario, need of importance of energy conversion,

Importance of energy audit, Procedure for carrying Energy Audit, Instruments used for energy audit, such as Power Analyser, Multipoint heat flow meter, Lux meter, Portable infrared Radiation thermometer, Thermocouple based temperature indicator. Payback period, Return on investment, Life cycle cost, Sankey diagram, Specific energy consumption.	
Total Lecture	**45 Hours**

Textbooks:	
1.	S. P. Sukhatme Solar Energy 3rd edition 2012 Tata Mc. Graw Hill Publication
2.	G. D. Rai, Solar Energy Utilization, 5TH ed 2014, Khanna Publishers
3.	Arora C.P.; Refrigeration and Air conditioning, 4th Ed.; 2021 Tata Mc Graw Hill Publication
4.	Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007
5.	Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.

Reference Books:	
1.	H P Garg, Solar Energy, Fundamental and Aplications, Tata Mc. Graw Hill Publication
2.	Dossat Roy J.; Principles of Refrigeration, 4th Ed.; Pearson Education Asia Publication
3.	Michela Raybova, Solar Energy Systems. Energy Science, Engineering and Technology. 2019
4.	Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017.
5.	Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
6	Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in
2.	https://archive.nptel.ac.in › courses

VII SEMESTER

22ME734 : PE-V:-SURFACE ENGINEERING

Course Outcomes :

Upon successful completion of the course, the students will be able to

- Select a conventional surface engineering treatment for a specific application
- Design a suitable thermal spray technique for surface modification of various materials
- Deploy laser modification of surfaces to enhance properties
- . Select and use an appropriate deposition technique for various materials

Unit:1	Introduction	8Hours

Fundamental of surface engineering – Philosophy of surface, broken bond concept, defects, general applications and requirements. Surface dependent properties and failures of engineering components. Surface engineering – Scope, Classification, definition and general principles.

Unit:2	Conventional Surface Engineering	8 Hours

Surface Degradation: Basic principles of electrochemistry and aqueous corrosion processes Oxidation and related concept Mechanical Friction and Wear like abrasive, erosive and sliding wear etc. Interaction between wear and corrosion. Conventional Techniques Cleaning, pickling, etching, grinding, polishing and diffusion process - carburizing, nitriding , Electroless and Electroplating , Anodization

Unit:3	Advanced Surface Engineering Practices	7 Hours

Thermal spray technologies –introduction - APS and HVOF - Effect of process parameters on coating properties , Cold spraying , warm spraying and Solution plasma spraying.

Unit:4	Laser surface modification

Laser hardening - Laser cladding - Laser texturing. Nano-coatings, Importance applications , Preparation of Nano-coatings

Unit:5	Thin film technologies	8 Hours

PVD and CVD Technologies - Evaporation –thermal and Electron beam - PVD, RF- DC, EBM,CVD-HFCVD, PECVD and ion implantation

Unit :6	Coating characterization	7 Hours

Plastic deformation based surface engineering techniques Industrial applications, Surface characterization ,Thickness and Roughness - Porosity and Adhesion

	Total Lecture	45 Hours

Text Books

1	T Burakowski and T. Wierzchon, *Surface engineering of metals*, CRC Press
2	A. W. Batchelor, L. N. Lam and M. Chandrasekaran, *Materials degradation and its control by surface engineering*, Imperial college press
3	Peter Martin, Introduction to Surface Engineering and Functionally Engineered Materials, Interscience Wiley, 2011
Reference Books	
1	Ainger and J. Blunt, *Engineering coatings*, William Andrew Publishing
2	Vijendra Singh, *Physical Metallurgy*, Standard Publisher
3	Steven Abbott, Nigel MacDermid, Nanocoating: Principles and Practice: From Research to Production, DEStech Publications, 2013.
4	Atul Tiwari, Lloyd Hihara, James Rawlins, Engineered Tribological Composites: The Art of Friction Material Development, 1st edition, Butterworth, 2014.
5	Angela Piegari, François Flory, Optical Thin Films and Coatings, 1st edition, Woodhead Publishing, 2013
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
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VII SEMESTER

22ME735 : PE-V:-Synthesis Of Mechanism

Course Outcomes :

Upon successful completion of the course, the students will be able to

- Describe the fundamentals of kinematic synthesis and its application.
- Formulate mathematical model of function generation, path generation and motion generation.
- Apply various graphical and analytical methods to design the mechanisms to meet kinematic needs.
- Evaluate the various optimisation techniques for synthesis.

Unit:1	**8Hours**

Introduction to kinematics, types of mechanism, kinematics synthesis, science of relative motion, tasks of kinematic synthesis with practical applications, Degree of freedom, class-I, class-II chain, Harding's notation, Grashof criterion, Grubler"s criterion

Unit:2	**8 Hours**

Introduction to position generation problem, concept of pole, two &three position generation synthesis, pole triangle, Relationship between moving & fixed pivots, Four position generation, opposite pole quadrilateral, center point &circle point curve, Burmester"s point. Matrix method for position generation problem, rotation matrix, displacement matrix

Unit:3	**7 Hours**

Introduction to function generation problem, co-ordination of input-output link motion, relative pole technique, inversion technique, overlay technique, graphical synthesis of quick return mechanisms for optimum transmission angle. Types of errors, accuracy points, cheby sher's spacing, frudenstein's equation with problems

Unit:4	**8 Hours**

Introduction to path generation problem, synthesis for path generation with and without prescribed timing using graphical method. Coupler curves, cognate linkages, Robert's law of cognate linkages. Complex numbermethod for path generation problem 3 precision points.

Unit:5	**8 Hours**

Synthesis for infinitesimally separated position, concept of polode and centrod, Euler's savery equation, inflection circle, Bobbilier and Hartman's construction

Unit :6	**7 Hours**

[8 hrs] Optimal synthesis of planer mechanisms, powell's search method, least square method, penalty function. Introduction to spatial mechanisms, D-H notations, introduction to kinematic analysis of robot arm.

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				Total Lecture	**45 Hours**
. Textbooks:					
S.N.	**Title of the book**	**Edition (Year of publication)**	**Author(s)**	**Publisher**	
1	Applied linkage synthesis	Fifth edition	Tao D.C.	New York, NY,	
2	Advanced mechanism design	1984	Erdman A.G.; Sandor G.N	Prentice-Hall, 1984	
3	Kinematics and mechanism design	Third edition 2010	Sue C.H; Radchiffe C.W		
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]					
1					
2					
MOOCs Links and additional reading, learning, video material					
1					

VII SEM B. Tech Mechanical
22ME736 : Turbines

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- The student will be able to describe and analyze the working of impulse water turbines.
- The student will be able to describe and analyze the working reaction water turbines.
- The student will be able to define evaluate Steam nozzles and; describe and analyze the impulse steam turbines, reaction steam turbines.
- The student will be able to describe and analyze the working of Gas turbines.

Unit:1	**Impulse Water Turbines**	**8 Hours**
Momentum Principle and its Application , Classification of water turbines, Pelton wheel, its construction and working, velocity triangles, efficiency, power, work done, Pelton wheel design, Governing of Pelton wheel		
Unit:2	**Reaction Water Turbines**	**7 Hours**
Principle of operation, Construction and working of Francis and Kaplan Turbine, Effect of modification of velocity triangles on runner shape, Draft tube, Cavitations calculation of various efficiencies, Power, Discharge, Blade angles, Runner dimensions etc. governing of Francis and Kaplan turbine, Draft tube types and analysis		
Unit:3	**Steam nozzles**	**8 Hours**
Compressible fluid flow, Static and Stagnation properties, Isentropic flow, Flow of fluid through nozzles, Continuity equation, Variation of velocity, area and specific volume, Mass of discharge, Maximum discharge, Critical pressure ratio, Choking, Effect of friction, Nozzles and Diffusers efficiency, Back pressure effect, Super saturated flow.		
Unit:4	**Impulse Steam turbines**	**8 Hours**
Types of turbines, Compounding, Velocity diagrams, Performance analysis, Reheat factor, Stage efficiency, Governing, and Losses in turbines.		
Unit:5	**Reaction Steam turbines:**	**7 Hours**
Types of turbines, Compounding, Velocity diagrams, Performance analysis, Reheat factor, Stage efficiency, Governing, and Losses in turbines.		
Unit :6	**Gas turbines**	**8 Hours**
Classification of gas turbines, Analysis, Regeneration, Inter-cooling, Reheating, Applications, Types of jet		

engines, Construction and working; propulsive efficiency.	
Total Lecture Hours	**45 Hours**

Textbooks:	
1.	Modi, PN, and Seth, SM, Hydraulics and Fluid Mechanics, Delhi Standard Publishers Distributors, 2015
2.	Rajput R.K, Thermal Engineering , 10th Edition, Laxmi Publications (P) Ltd, 2017

Reference Books:	
1.	Banga & Sharma, Hydraulic Machines, Khanna Publishers, 2019
2.	Nag P K, Thermal Engineering, Tata McGraw-Hill Education, 2020.
3.	Soman.K, Thermal Engineering, PHI Learning Private Ltd, 2016.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781119902973.ch4
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119902973?SeriesKey=10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112106133
2.	https://nptel.ac.in/courses/112103249

VII SEMESTER

22ME737 : Control System Engineering

Course Outcomes :

Upon successful completion of the course, the students will be able to;

1. Illustrate the mathematical representation of various control system and determine the transfer function of mechanical, electrical, thermal and fluid system.
2. Analyse the working of various control system components of electrical motor and hydraulic system..
3. Evaluate the performance of control system using time response analysis.
4. Create the performance of control system on the basis of frequency response and root locus and design suitable compensation for the control system.

I	Introduction:- **8 Hours** Introduction, System concept Open and Closed loop control systems. Transfer function, Mathematical Modelling of Physical System and system representation through Block Diagram. Transfer function through Block Diagram Simplification. Signal Flow Graph, Masons Gain Formula Block diagrams of various control systems.
II	Mathematical Modelling:- **7 Hours** Representation of Control components: Mechanical and Electrical components; Analogous systems.
III	Electrical system:- **8 Hours** Ac/dc servomotors; field controlled and armature-controlled servomotors; positional servomechanisms, Potentiometer, Synchro, stepper motors. Hydraulic systems: - Hydraulic pumps (gear; vane; and reciprocating piston) Cylinders, Direction control valves (2, 3, 4 way) Flow control valve; Relief valve Hydraulic servomotor
IV	Time response analysis:- **7 Hours** Transient and steady state response of first and second order systems Concept of stability; relative stability; Routh stability criteria.
V	Bode and Polar plot:- **8 Hours** Frequency response and its characteristics; Bode plots; Polar plots, Nyquist plots. Gain margin and phase margin. Identification of system transfer function
VI	Root Locus:- **7 Hours** Basic control actions; Proportional Integral and Derivative control actions and their effect on system performance. Root locus technique. Introduction to control system design log load compensation Feed Back Compensation and Pole -Zero placements

Total Lecture	45 Hours

Text books	
1	Modern Control Engineering 3rd Edition (2009) Ogata Prentice Hall
2	Control system Engineering 4th Edition (2007) Nise John Wiley & Sons
Reference Books	
1	Control system 4th Edition (2009) Nagrath & Gopal New Age International
2	Modern Control System 12th Edition (2009) Dorf Pearson
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

VII SEMESTER
22ME738 : Machine Tool Design

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Explain the drives and mechanisms of machine tools
- Design Gear boxes of machine tools
- Design machine tool structures, guide ways and power screws, spindles and supports of machine tools.
- Test the machine tools and examine the control system of machine tools.

I	Introduction:- **7 Hours** Introduction to Machine tool drives & Mechanisms, Working & auxiliary motions in machine tools, Parameters defining the working motions of a machine tool; Machine tool drives, Hydraulic Transmission & its elements, Mecll.'U1ical Transmission & its elements, General requirements of machine tool design, layout of machine tool
II	Regulation of speed & feed rates - Aim of speed & feed regulation, Stepped regulation of speed -Various laws of stepped regulation, Selection of range ratio, Standard values of Geometric progression Ratio & guidelines for selecting proper value, break up of speed steps; Structure diagrams & their analysis, Speed classification. Design of feed box, machine tool drives using multiple speed motors, Special cases of gear box design -speed box with overlapping speed steps, speed box with a combined structure, speed box Wit11 broken geometric progression, General recommendation for developing the Gearing diagram, determining the Number of teethes of gears, Classification of speed & feed boxes. Electromechanical system of Regulation, Friction, Pressure and Ball Variation, Epicyclic Drive **8 Hours**
III	**8 Hours** Machine Tool Structure - Functions of machine tool structures & their requirements, Design criteria for machine tool structU1.es, Materials of machine tool structures, Static &Dynamic stiffness, Profiles of machine tool structures, Factors affecting stiffness of machine tool structures & methods of improving it; Basic design procedure of machine tool structures -design for strength, design for stiffness. Design of Beds, Column, housings, Bases & Tables, Cross Rails, Arms, Saddles, Carriages, Rams
IV	Design of Guide ways & Power Screws - Functions & types of guide ways, Design of Sideways - Shapes, materials, methods of adjusting clearances. Design Criteria & Calculations for sideways, Design for wear resistance, Design for stiffness. Guide ways operating under liquid friction conditions -Hydrodynamic & Hydrostatic sideways, Design of Aerostatic sideways, Design of Antifriction Guide ways, Combination guide ways, protecting devices for sideways. n of Power Screws -Sliding friction power screws, Rolling friction Power Screws. **7 Hours**
V	Design of Spindles & Spindle Supports Functions of spindle unit & requirements, Materials of spindles, design calculations of spindles – Deflection of spindle axis due to bending, deflection

	of spindle axis due to compliance of spindle supports, optimum spacing between spindle supports deflection due to compliance of the Tapered Joint permissible deflection & design for stiffness. Antifriction bearings -Preloading of antifriction bearing. Sliding bearings - Sleeve bearings, hydrodynamic journal bearing, and air -lubricated bearings **8 Hours**
VI	Testing and Control of Machine Tools a) Testing: Objects and procedure for Acceptance Test, Instrumentation for acceptance, Accuracy of machine tools, and accuracy of work pieces. b) Control systems: Electrical control, push-button control, directional control relays, electrical brakes, automation in feed mechanism c) Hydraulic control: positional control, power pack for lubrication system in hydraulic drive. d) Control system for gear sliding and feed mechanism (open loop or close loop) for NC/CNC machine using stepper motor or DC motor **7 Hours**
Total Lecture	45 Hours

Text books:

S.N.	Title of the book	Edition (Year of publication)	Author(s)	Publisher
1	Machine Tool Design	2007	N. K. Mehata	Tata McGraw-Hill, 1984
2	Principles of Machine Tools	2011	Gopal Chandra Sen, Amitabha Bhattacharyya	New central book agency
3	Design Of Machine Tools	5th edition 2008	Basu, Pal	Oxford and IBH Publishing, 2008
4	Principles of Machine tools		Sen and Bhattacharya	New central book agency

Reference Books

1	"Machine Tool Design Handbook" by Central Machine Tool Institute (CMTI)
2	"Machine Tools Design, Reliability and Safety" by N. S. Acherkan

YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]

1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186

MOOCs Links and additional reading, learning, video material

1	https://archive.nptel.ac.in/courses/107/106/107106088/

VII SEMESTER

22ME751 : PE VI : Stress Analysis

Course Outcomes :
Upon successful completion of the course, the students will be able to; 1. **Describe** the behavior of materials under various loading conditions. 2. **Apply** principles of stress analysis to calculate stresses in beams, shafts, and other structural elements. 3. **Analyze** the stress distribution in structures using analytical and numerical methods.. 4. **Evaluate** the adequacy of structural designs under given loading conditions using stress analysis results.

I	Two Dimensional Problems in. Cartesian Coordinate system -Fundamentals of stress & strain, stress-strain relationship, Elastic constant, plane stress, plane strain., differential equation of equilibrium Boundary conditions, Saint Venant's principle, compatibility equation, Airys stress function. Stress analysis of cantilever subjected to concentrated load at its end and simply supported beam subjected to uniformly distributed load **(8 Hours)**
II	Two dimensional problem in polar coordinate systems -General equations of equilibrium in polar coordinate compatibility equation, stress distribution about symmetric. axis, stress analysis of cylinder subjected to ~ internal & external pressure, Pure bending of curved beams, effect of hole on the stress distribution in plates, Stress analysis of rotating circular disk **(7 Hours)**
III	Two Dimensional Photoelasticity - Introduction to basic optics related to photoelasticity, stress optic law, plane & circular polariscope arrangements, effect of stressed model in plane & circular polariscope, Isoclinic & Isochromatics, stress trajectories, calibration of photoelastic material (determination of fringe constant). various photoelastic materials and their properties, Casting of photoelastic models, Tardy's compensation technique, Separation techniques like, shear difference, oblique incidence & electrical analogy. **(8 Hours)**
IV	Introduction to 3-D photoelasticity -Phenomenon of Stress freezing, Method of stress freezing, slicing techniques, determination of material fringe constant at critical temperature. Scaling Model- Prototype relations. Birefringerent coating method -Reflection polariscope. Introduction to fringe sharpening & fringe multiplication **(7 Hours)**
V	Strain gage technique for stress & strain analysis -Introduction to electrical resistance strain gages, gage . factor, bridge circuit, bridge balance, output voltage of Wheatstone bridge, balancing of bridge, temperature compensation, various bridge configurations, bonding of strain gages to the specimen, determination of principle strains & stresses using strain rosettes. Environmental effects on performance of strain gages, Strain gages response to dynamic strains, Effect of lead wires.Introduction to Strain measurement on rotating components, Static & Dynamic Strain Measurement introduction to semiconductor gages, high temperature strain gages & self-temperature compensated gages. Introduction to Commercial strain indicators. **(8 Hours)**
VI	Grid technique of strain analysis, Brittle coating method for stress & strain analysis, Moire fringe method for stress & strain analysis **(7 Hours)**
Total Lecture	45 Hours

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Text books	
1	Theory of Elasticity -S.P. Timoshenko
2	Experimental Stress Analysis -Dally & Riley
Reference Books	
1	Timoshenko, "Advance Strength of Materials", vol 1 & 2, CBS.
2	Den Hartog, "Advance Strength of Materials" McGrawHill, 1952.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781118536186
MOOCs Links and additional reading, learning, video material	
1	https://archive.nptel.ac.in/courses/107/106/107106088/

VII SEMESTER
22ME752 : PE VI : Product Design and Development

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- **Identify** potential risks and challenges in the product development process and suggest mitigation strategies.
- **Evaluate** the feasibility of product concepts through prototyping and testing.
- **Develop** innovative product solutions that address specific user needs and market demands.
- **Propose** strategies for continuous improvement and innovation in the product development process.

Unit:1	Introduction	8 Hours

Importance of product design, types of design, product definition, product specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, concept generation and evaluation methods.

Unit:2	Material and Process Selection	7 Hours

Material selection – Importance, classification, material performance characteristic, Selection criteria, Ashby Material selection chart. Process selection – Importance types of manufacturing processes and their classification, sources of information, selection criteria, Material and Process selection Methods- Expert systems, Computer Database Approach, Performance indices, decision matrix, AHP and fuzzy approach, introduction to material and process selection software

Unit:3	Value Engineering	8 Hours

Introduction to Value Engineering (V.E.) and Value Analysis, Types of Value, Types of Functions, Introduction to V.E. Job plan / Functional Approach to ValueImprovement, Various phases and techniques of the job plan,Fast diagramming DARSIRI method of value analysis.

Unit:4	Benchmarking	8 Hours

Benchmarking – DFM, DFA, DFX, Early supplier involvement, robust design, QFD and concurrent engineering.

Unit:5	Product Costing	7 Hours

Mathematics of Time Value of Money, Cost Comparison, Depreciation, Taxes, Inflation, Profitability of Investment and Investment Decision Analysis Sensitivity Analysis. Methods of Cost Estimates.

Creative thinking and creative judgment

Unit :6	Rapid Prototyping	8 Hours

Product Development Cycle and Importance of Prototyping, Types of Prototypes, Principle and Advantages &

Different Type of Generative Manufacturing Process, Viz, Stereolithography, FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Considerations	
Total Lecture Hours	**45 Hours**

Textbooks:	
1.	Dieter George E. "Engineering Design", McGraw Hill Pub. Company, 2000
2.	Ulirich Karl T. and Eppinger Steven D., "Product Design and Development" McGraw Hill Pub. Company, 1995

Reference Books:	
1.	HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.
2.	BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.
3.	HARRY B.WATTON, " New Product Planning ", Prentice Hall Inc. 1992.

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://onlinelibrary.wiley.com/doi/10.1002/9781119902973.ch4
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119902973?SeriesKey=10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112106133
2.	https://nptel.ac.in/courses/112103249

VII SEM B. Tech Mechanical
22ME753 : PE VI : Power Plant Engineering

Course Outcomes :

Upon successful completion of the course, the students will be able to;

1. The student will be able to apply the knowledge of thermodynamic law and understand the various systems of thermal power plant.
2. The student will be able to Understand and analyse of hydraulic power plants
3. The student will be able to Analyse economics of power plants and list factors affecting the power plants load & Evaluate economic condition of power generations systems
4. The student will be able to Understand and analyse nuclear power plant and discuss safety aspect

Unit:1	THERMAL POWER PLANT- I	8 Hours

Introduction to thermal power plants and power plant layouts. Fuel characteristics, handling, storage, preparation & firing methods. Ash & dust collection and handling. Boiler: classification, general arrangement, details of different components and system like draught system, steam turbine systems, condenser, cooling towers, water treatment, Waste Disposal-Present practices, environmental hazards and other social aspects.

Unit:2	THERMAL POWER PLANT- II	8 Hours

Gas Turbine Power Plant: -Introduction, power plant layouts, Open cycle, close cycle power plants. Various components and systems. Methods to improve efficiency. Reheat and Regeneration cycle and their combinations Diesel Electric Power Plant: - Introduction, Outline, type of engines, different components, performance, plant layout. Comparison with other power plant. Introduction to captive power plant.(To study the practical aspect ot power plant,the visit to nearby power plant shall be arrange for the students)

Unit:3	HYDROELECTRIC POWER PLANT	7 Hours

Hydrology: - Rainfall, Runoff, Hydro graph, flow duration curve, mass curve. Hydroelectric power plant: - Site selection, classification of hydroelectric power plant, general arrangement, details of different components, turbine selection, models & model testing, governing. Comparison with other power plant.

Unit:4	POWER PLANT ECONOMICS	8 Hours

Load Analysis - Fluctuating Load on power plants, Load curves, various terms & definition, peak load, effect of fluctuating load

Economic Analysis: - Cost of electric energy, load division, and. Tariff methods for Electrical Energy

Unit:5	NUCLEAR POWER PLANT	7 Hours

Introduction to Nuclear Engineering, Global scenario, prominent installations worldwide, present & proposed

nuclear plant in India. Nuclear Reactors: - Types of reactors, PWR, BWR, CANDU, Gas cooled, liquid metal cooled, Breeder reactor. Operational requirements and difficulties, site selection for location of a nuclear power station Nuclear Waste Disposal-Present practices, environmental hazards and other social aspects. Comparison with other power plant.

Unit :6	**COMBINED OPERATION OF DIFFERENT POWER PLANTS**	**7 Hours**

Combined operation: - Need division, combination of different plant & their coordination, advantages. NON CONVENTIONAL POWER GENERATION SYSTEMS Introduction to Non Conventional power Generation Systems Geo-Thermal Power Plant, Tidal Power Plant, Wind Power Plant, Solar Power Plant Global scenario, prominent installations worldwide present & proposed plant locations.

Total Lecture Hours	**45 Hours**

Textbooks:	
1.	Modi, PN, and Seth, SM, Hydraulics and Fluid Mechanics, Delhi Standard Publishers Distributors, 2015
2.	Rajput R.K, Thermal Engineering , 10th Edition, Laxmi Publications (P) Ltd, 2017
3	Arora, Domkundwar, Power Plant Engineering, Dhanpat Rai & Co, 2017
4	Nag P K, Power Plant Engineering, Tata McGraw-Hill Education, 2015.

Reference Books:	
1.	Banga & Sharma, Hydraulic Machines, Khanna Publishers, 2019
2.	Nag P K, Thermal Engineering, Tata McGraw-Hill Education, 2020.
3.	Soman.K, Thermal Engineering, PHI Learning Private Ltd, 2016.

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MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112106133
2.	https://nptel.ac.in/courses/112103249

VII SEM B. Tech Mechanical
22ME754 : PE VI : IoT in ME

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Identify the hardware and software components required for IoT system development.
- Develop and prototype IoT devices using popular development platforms.
- Test and validate IoT systems to ensure functionality and performance.
- Propose innovative solutions for integrating IoT with renewable energy systems.

Unit:1	Introduction to IoT and Its Applications in Mechanical Engineering	8 Hours

Definition, history, and evolution of IoT, Key components: sensors, actuators, connectivity, and data processing. IoT architecture: device layer, network layer, and application layer, Smart Manufacturing and Industry 4.0., Predictive maintenance and condition monitoring, IoT in HVAC (Heating, Ventilation, and Air Conditioning) systems., Smart energy management in industrial plants, IoT in transportation and logistics.

Unit:2	Sensors and Actuators in IoT Systems	8 Hours

Types of sensors used in mechanical systems: temperature, pressure, vibration, proximity, and flow sensors., Working principles and selection criteria for different applications, Sensor interfacing and calibration techniques. Types of actuators: electric motors, pneumatic and hydraulic actuators, and smart materials, Integration of actuators with IoT systems, Control strategies for actuators in IoT applications. Data acquisition systems (DAQ): architecture and components. Signal conditioning and data conversion. Basics of signal processing for IoT applications.

Unit:3	IoT Communication Protocols and Network Architectures	7 Hours

Wired protocols: Modbus, CAN, Ethernet, Wireless protocols: Wi-Fi, Zigbee, Bluetooth, LoRaWAN, NB-IoT, Comparison and selection of communication protocols for different applications, IoT network topologies: star, mesh, and hybrid networks, Cloud-based IoT architectures vs. Edge computing, IoT gateways and their role in communication and data processing. Threats and vulnerabilities in IoT systems. Security measures: encryption, authentication, and authorization Privacy concerns and data protection strategies.

Unit:4	IoT Data Analytics and Machine Learning	8 Hours

Data collection, storage, and management in IoT systems, Introduction to big data and its relevance to IoT,

Data visualization techniques and tools., Basics of machine learning: supervised, unsupervised, and reinforcement learning., Machine learning algorithms for predictive maintenance and anomaly detection., Implementation of machine learning models on edge devices

Unit:5	IoT System Design and Development	7 Hours

Requirements analysis and specification for IoT systems., Hardware and software selection for IoT

Projects., System integration and interoperability issues., Overview of popular IoT development platforms: Arduino, Raspberry Pi, ESP8266/ESP32., Introduction to IoT development frameworks: Node-RED, Things Board, and Kaa., Software tools for IoT development: IDEs, simulators, and debuggers .**Prototyping and Testing:** Rapid prototyping techniques for IoT devices., Testing and validation of IoT systems., Best practices for deployment and maintenance.

Unit :6	**Future Trends and Innovations in IoT for Mechanical Engineering**	**7 Hours**

- **Advanced IoT Technologies:** Role of artificial intelligence and machine learning in IoT., Edge computing and its impact on real-time IoT applications., Integration of IoT with blockchain for secure and transparent operations. **Emerging Trends:** IoT in robotics and automation., Digital twins and their applications in mechanical engineering.,IoT in renewable energy systems and smart grids. **Research and Development:** Current research topics in IoT for mechanical engineering., Future directions and innovations in IoT technology., Challenges and opportunities for mechanical engineers in the IoT domain.

	Total Lecture Hours	**45 Hours**

Textbooks:	
1.	"Internet of Things: Principles and Paradigms" by Rajkumar Buyya and Amir Vahid Dastjerdi.
2.	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, and Jerome Henry.

Reference Books:	
1.	"Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz.
2.	Research papers and articles from IEEE IoT Journal and other reputable sources.

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1	https://onlinelibrary.wiley.com/doi/10.1002/9781119902973.ch4
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9781119902973?SeriesKey=10.1002/9780470168042

MOOCs Links and additional reading, learning, video material	
1.	https://nptel.ac.in/courses/112106133
2.	https://nptel.ac.in/courses/112103249

VIISEMESTER

22ME755 :PE:-VI DESIGN OF EXPERIMENT AND TAGUCHI METHOD

Course Outcomes :
Upon successful completion of the course, the students will be able to; 5. **Apply** the knowledge of Frequency Distribution and **Analyze** the data by using Histograms and Probability distribution 6. **Evaluate** the Design of experiments for Engineering Process. 7. **Distinguish** and **Analyze** the different optimization techniques 8. **Analyze** the variance in observation data.

Unit I: Frequency Distribution	**(8 Hrs.)**
Frequency Distribution & Histograms, Probability & its Distribution, Measures of Central Tendency & Distribution, Presentation of Statistical Data. Importance and significance of statistics in an engineering industry.	
Unit II: Confidence intervals	**(7 Hrs.)**
Confidence intervals, Hypothesis Testing, Correlation, Liner & Multiple Repression Analysis, Signification Testing, Introduction to MINITAB.	
Unit III: Factorial Methods	**(8 Hrs.)**
Full & fractional factorial experiments, analysis of variance, Latin squares, response surface methodology	
Unit IV: Taguchi Method	**(7 Hrs.)**
Taguchi Method: - Introduction, System Design, Parameter Design and Tolerance Design. Quality, Taguchi Quality Loss Function, Classification of Parameters, Process Diagram (P-Diagram	
Unit V: Signal to Noise Ratio	**(8 Hrs.)**
Signal to Noise Ratio & its Types, Equations of S/N ratio. Steps of Taguchi Method, Design of Experiments (DOE), Orthogonal Array (OA), Selection of OA, Computation of Number of experimentation, Comparison of Taguchi Method to Conventional Methods.	
Unit VI: Response Table and ANOVA	**(7 Hrs.)**
Response Table, Selection of Rank for process parameters, Main Effect Plot, Identification of Optimal setting, Analysis of Variance (**ANOVA**), Additive model, Computation of Predictive output parameters. Verification of predictive model by confirmatory test.	
Total Lecture	**45 Hours**

Textbooks:

1.	Thomas P. Ryan, Statistical Methods for Quality Improvement, John Wiley & Sons, 2011
2.	George W. Cobb and David A. S. Fraser, Introduction to Design and Analysis of Experiments, 2015
3.	William G. Cochran , Gertrude M. Cox , Experimental Designs (Wiley Series in Probability and Statistics), 2005

Reference Books:	
1.	J. Susan Milton, Jesse Arnold, Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences Mc. Graw Hill Publication, 2002.
2.	Ross, Phillip J , Taguchi techniques for quality engineering, New York : McGraw-Hill 2021
3.	Madhav S. Phadke , Quality Engineering Using Robust Design, Pearson, 2008

MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/watch?v=v_HeaeUUOnc
2.	https://www.youtube.com/watch?v=BIlH-sIYo-8
3.	https://www.youtube.com/watch?v=YcqzmJFnOJE

VII SEMESTER
22ME756 : PE VI : Non-Destructive Testing

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Illustrate surface NDE techniques that enable to carry out various inspections as per the established procedures
- Differentiate various defect types and select the appropriate NDT methods for the specimen.
- Apply the methods to check surface defects
- Demonstrate the methods to identify subsurface and volumetric defects

Unit I: Introduction to NDT	**(7 Hrs.)**
Introduction to NDT, Comparison between destructive and NDT, Importance of NDT, Scope of NDT, difficulties of NDT, future progress in NDT, economics aspects of NDT, **Visual Inspection** - tools, applications, and limitations -Fundamentals of visual testing: vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibrscopes, special lighting systems, computer-enhanced system	
Unit II: Liquid Penetrant Inspection	**(7 Hrs.)**
Liquid Penetrant Inspection: principles, properties required for good penetrants and developers - types of penetrants and developers, advantages and limitations of various methods of LPI – LPI technique/ test procedure, interpretation and evaluation of penetrant test indications, false indication, safety precaution required in LPI, applications, advantages and limitations	
Unit III: Magnetic Particle Inspection (MPI)	**(7 Hrs.)**
Principles of MPI, basic physics of magnetism, permeability, flux density, cohesive force, magnetizing force, rentivity, residual magnetism, Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique, central conductor testing, magnetization using products using yokes, direct and indirect method of magnetization, continuous testing of MPI, residual technique of MPI, system sensitivity, checking devices in MPI, Interpretation of MPI, indications, advantage and limitation	
Unit IV: Ultrasonic Testing (UT)	**(8 Hrs.)**
principle, types of waves, frequency, velocity, wavelength, reflection, divergence, attenuation, mode conversion in ultrasonic UT testing methods, contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques, resonance testing, through transmission technique, pulse-echo testing technique, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used Reference blocks with artificially created defects, calibration of equipment, Applications, advantages, limitations, A, B and C scan	
Unit V: Radiography Testing (RT)	**(8 Hrs.)**
Principle, electromagnetic radiation sources: X-ray source, production of X-rays, high energy X-ray source, gamma-ray source - Properties of X-rays and gamma rays, Inspection techniques like SWSI, DWSI, DWDI, panoramic exposure, real-time radiography, films used in industrial radiography, types of film, speed of films, qualities of film, screens used in radiography, quality of a good radiograph, film	

processing, interpretation, evaluation of test results, safety aspects required in radiography, applications, advantages and limitations of RT	
Unit VI: Eddy Current Testing (ECT)	**(8Hrs.)**
Principle, physics aspects of ECT like conductivity, permeability, resistivity, inductance, inductive reactance, impedance, Field factor and lift of effect, edge effect, end effect, impedance, plane diagram in brief, depth of penetration of ECT, the relation between frequency and depth of penetration in ECT, equipment and accessories, various applications of ECT such as conductivity measurement, hardness measurement, defect detection, coating thickness measurement, advantages and limitations of eddy current testing	
Total Lecture	**45 Hours**

Textbooks:	
1.	Baldev Raj, Practical Non – Destructive Testing, Narosa Publishing House ,1997
2.	J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw Hill Education Private Limited Education Private Limited, 2003.
3.	Cartz L. – 'Non-Destructive testing' – ASM International, Metals Park Ohio, US – 1995

Reference Books:	
1.	ASM Metals Hand Book, 'Non-Destructive Evaluation and Quality Control' – American Society of Metals, Metals Park Ohio, USA – 1989
2.	https://www.nde.com/ndt-levels-i-ii-iii/
3.	https://www.nde-ed.org/NDETechniques/index.xhtml

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/@theoryandpracticeofnondest7289
2.	https://archive.nptel.ac.in/courses/113/106/113106070/

VII SEMESTER

22ME757 : PE VI : Computational Methods in ME

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Explain the principles behind numerical methods and their applications
- Apply numerical methods to solve engineering problems using computational tools such as MATLAB or Python..
- Analyze the accuracy, stability, and efficiency of different numerical methods
- Develop and integrate computational solutions to complex mechanical engineering problems

Unit I: Introduction to Computational Methods	**(7 Hrs.)**
• **Overview of Computational Methods**: Definition, importance, and applications in mechanical engineering.• **Mathematical Preliminaries**: Review of linear algebra, calculus, and differential equations.• **Computational Tools**: Introduction to MATLAB, Python, and other relevant software. • **Error Analysis**: Types of errors (truncation, round-off), error propagation, and stability.	
Unit II: Numerical Linear Algebra	**(7 Hrs.)**
• **Matrix Operations**: Matrix addition, multiplication, and inversion. • **Systems of Linear Equations**: Direct methods (Gaussian elimination, LU decomposition), Iterative methods (Jacobi, Gauss-Seidel, Conjugate Gradient). • **Eigenvalue Problems**: Power method, Jacobi method for eigenvalues.	
Unit III: Numerical Solutions of Nonlinear Equations	**(7 Hrs.)**
• **Root-Finding Algorithms**: Bisection method, Newton-Raphson method, Secant method. • **Systems of Nonlinear Equations**: Fixed-point iteration, Newton's method for systems.	
Unit IV: Numerical Differentiation and Integration	**(8 Hrs.)**
• **Numerical Differentiation**: Finite difference methods, error analysis. • **Numerical Integration**: Trapezoidal rule, Simpson's rule, Gaussian quadrature. • **Applications**: Solving practical engineering problems involving integration and differentiation.	
Unit V: Numerical Solutions of Differential Equations	**(8 Hrs.)**
• **Ordinary Differential Equations (ODEs)**: Initial value problems (Euler's method, Runge-Kutta methods), Boundary value problems (Shooting method, Finite difference method). • **Partial Differential Equations (PDEs)**: Classification of PDEs, Finite difference method for PDEs, Introduction to Finite Element Method (FEM)	
Unit VI: Optimization Methods	**(8Hrs.)**
• **Optimization Fundamentals**: Definition and types of optimization problems. • **Unconstrained Optimization**: Gradient descent, Newton's method, Conjugate gradient method. • **Constrained Optimization**: Lagrange multipliers, Linear programming (Simplex method), Non-linear programming. • **Applications in Mechanical Engineering**: Structural optimization, design optimization, and other relevant case studies.	
Total Lecture	**45 Hours**

			July 2022	1.00	Applicable for AY 2022-23 Onwards
Chairperson	Dean (Acad. Matters)	Dean OBE	Date of Release	Version	

Textbooks:	
1.	"An Introduction to Numerical Methods and Analysis" by James F. Epperson
2.	Applied Numerical Methods with MATLAB for Engineers and Scientists" by Steven C. Chapra
3.	Computational Methods for Engineers" by Robert J. Schilling and Sandra L. Harris

Reference Books:	
1.	Numerical Recipes: The Art of Scientific Computing" by William H. Press, Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery
2.	Fundamentals of Engineering Numerical Analysis" by Parviz Moin
3.	"Numerical Methods for Scientific Computing: A MATLAB-Based Approach" by Jeffrey R. Chasnov

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MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/@theoryandpracticeofnondest7289
2.	https://archive.nptel.ac.in/courses/113/106/113106070/

VII SEMESTER
22ME771 : PE7: Engineering failure Analysis

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Explain the principles of failure mechanisms and the factors that influence them
- Apply failure analysis techniques to investigate and diagnose engineering failures.
- Analyze failure data to determine the root cause of engineering failures.
- Evaluate the effectiveness of failure prevention measures.

Unit I: Introduction to Failure Analysis	**(7 Hrs.)**
• **Overview of Failure Analysis**: Definition, importance, and objectives. • **Historical Case Studies**: Notable engineering failures and lessons learned. • **Basic Concepts**: Types of failures (mechanical, thermal, chemical, etc.), failure modes, and failure criteria.	
Unit II: Materials and Their Behavior	**(7 Hrs.)**
• **Material Properties**: Mechanical properties (strength, toughness, hardness), thermal properties, and chemical properties. • **Deformation and Fracture**: Elastic and plastic deformation, ductile and brittle fracture. • **Material Selection**: Criteria for selecting materials for different engineering applications.	
Unit III: Failure Mechanisms	**(7 Hrs.)**
• **Fatigue**: Mechanism of fatigue failure, S-N curves, fatigue life prediction. • **Creep**: Creep mechanisms, creep curves, and creep-resistant materials. • **Corrosion**: Types of corrosion (uniform, pitting, galvanic, etc.), corrosion mechanisms, and prevention methods. • **Wear**: Types of wear (abrasive, adhesive, erosive), wear mechanisms, and mitigation techniques.s	
Unit IV: Failure Analysis Techniques	**(8 Hrs.)**
• **Visual Inspection**: Macroscopic examination, common visual indicators of failure. • **Non-Destructive Testing (NDT)**: Ultrasonic testing, radiography, magnetic particle testing, dye penetrant testing. • **Fractography**: Examination of fracture surfaces using optical microscopy and scanning electron microscopy (SEM). • **Metallography**: Microstructural analysis using optical microscopy, preparation of metallographic samples.	
Unit V: Root Cause Analysis	**(8 Hrs.)**
• **Data Collection and Analysis**: Gathering failure data, statistical analysis, and interpretation. • **Stress Analysis**: Analytical methods, finite element analysis (FEA), and identifying stress concentrations. • **Fracture Mechanics**: Stress intensity factors, crack propagation, and fracture toughness.	

• **Case Studies**: Detailed analysis of real-world failure cases, application of root cause analysis techniques.	
Unit VI: Prevention and Mitigation Strategies	**(8Hrs.)**
• **Design for Reliability**: Principles of robust design, safety factors, and redundancy. • **Material and Process Improvement**: Enhancing material properties, improving manufacturing processes. • **Maintenance and Inspection**: Preventive and predictive maintenance, regular inspection protocols. • **Failure Reporting and Documentation**: Writing comprehensive failure analysis reports, documenting findings and recommendations.	
Total Lecture	**45 Hours**

Textbooks:	
1.	"Engineering Failure Analysis: A Case Study Approach" by Theodore L. Anderson
2.	"Failure of Materials in Mechanical Design: Analysis, Prediction, Prevention" by Jack A. Collins
3.	Failure Analysis of Engineering Materials" by Charles R. Brooks and Ashok Choudhury

Reference Books:	
1.	Metallurgical Failure Analysis" by Kannadi Palankeezhe Balan
2.	"Failure Analysis and Prevention" (ASM Handbook, Volume 11) by ASM International
3.	Fractography and Failure Analysis" by John J. G. Fatigue, T. R. Shives, and Colin GaggR. Chasnov

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MOOCs Links and additional reading, learning, video material	
1.	https://www.youtube.com/@theoryandpracticeofnondest7289
2.	https://archive.nptel.ac.in/courses/113/106/113106070/

VII SEMESTER
22ME772 : PE-VII : VIBRATIONS

Course Outcomes:

Upon successful completion of the course the students will be able to

1. **Analyze** the various types of vibrations
2. **Evaluate** vibrations and carry out its analysis.
3. **Determining** vibration parameters using Various Vibration pickup
4 **INTEGRATING** on transformation of matrices for vibration for **Evaluating** frequencies

Unit:1	SINGLE DEGREE OF FREEDOM	6 Hours

Free body diagram, free & forced vibration, un damped and damped single degree of freedom systems subjected to harmonic and other periodic excitations. Vibration isolation and transmissibility

Contemporary Issues related to Topic

Unit:2	TWO DEGREE OF FREEDOM	7 Hours

Energy method applied to TWO degree of freedom system. Lagrange's equation. Generalized mass formulation of mass, damping and stiffness matrix and its numerical solutions. Vibration absorber, . Geared rotor system Mode shapes and orthogonality principle

Contemporary Issues related to Topic

Unit:3	M.d.o.f. VIBRATION systems	7 Hours

Numerical techniques for M.d.o.f. systems. Matrix iteration method. Holzer‟s method for torsional vibration. Dunkeleys method for critical speed determination of multi disc rotor. Rayleigh quotient sweeping matrix method for determination of all the natural frequencies and mode shapes. Free and forced response through modal analysis

Contemporary Issues related to Topic

Unit:4	Continuous VIBRATION system	6 Hours

Vibration of continuous system. Axial vibration of rod, bending vibration of beam and torsional vibration of shaft. Hamiltons principle and derivation of equation of motion, Rayleigh quotient, Modal co-ordinates, Free and

forced response through modal analysis **Contemporary Issues related to Topic**		
Unit:5	**Vibration pickup**	**7 Hours**
Vibration pickup, seismometers, accelerometer, proximity probe spectrum analyser, FET & DFT (Discrete FFT), torsional, Vibration measurement, philosophy of vibration. condition monitoring **Contemporary Issues related to Topic**		
Unit :6	**Finite element method in vibration**	**6 Hours**
Introduction to Finite element method in vibration of continuous system. Natural frequencies and mode shape computation for simple rod or beam problem **Contemporary Issues related to Topic**		
	Total Lecture Hours	**39 Hours**

Text books	
1	Rao J.S.;Gupta K , Mechanical vibration, Wiley Eastern, c1984
Reference Books	
1	Thomson W.T, Theory of vibration, Prentice hall
2	Rao J.S, Advanced theory of vibration Wiley, 1992
3	Rao J.S, Vibration condition Monitoring of Machines, Alpha Science International Limited, 2000
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/112/107/112107212
2	https://nptel.ac.in/courses/112/104/112104121
3	https://nptel.ac.in/courses/112/105/112105124

VII SEMESTER
22ME773 : PE-VII : Gas Dynamics and Jet Propulsion

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Describe the working principles of various jet propulsion engines and their components.
2. Calculate the performance parameters of different jet engines, such as thrust, specific impulse, and efficiency.
3. Analyze the flow characteristics in subsonic, transonic, supersonic, and hypersonic regimes.
4. Design basic components of jet propulsion systems, such as nozzles and diffusers, using principles of gas dynamics.

Unit:1	Fundamentals of Gas Dynamics	6 Hours

- **Introduction to Gas Dynamics**
  - Basic concepts and definitions
  - Thermodynamic properties of gases
  - Continuum assumption
- **Conservation Laws**
  - Conservation of mass, momentum, and energy
  - Control volume approach
  - Integral and differential forms of governing equations
- **Isentropic Flow**
  - Isentropic flow relations
  - Stagnation properties
  - Area-velocity relation for isentropic flow

Unit:2	Normal and Oblique Shock Waves	7 Hours

- **Normal Shocks**
  - Basic features and equations
  - Normal shock relations
  - Hugoniot equation

- **Oblique Shocks**
  - Oblique shock relations and theta-beta-Mach diagram
  - Shock polar diagrams
  - Shock reflection and interaction
- **Prandtl-Meyer Expansion**
  - Prandtl-Meyer function
  - Supersonic expansion and compression
  - Applications in nozzles and diffusers

Unit:3	Compressible Flow in Ducts	7 Hours

- **Flow in Variable Area Ducts**
  - Nozzles and diffusers
  - Flow through convergent and convergent-divergent nozzles
  - Choking phenomena
- **Fanno Flow**
  - Adiabatic flow with friction
  - Fanno line and its applications
  - Fanno flow equations
- **Rayleigh Flow**
  - Flow with heat addition or removal
  - Rayleigh line and its applications
  - Rayleigh flow equations

Unit:4	Fundamentals of Jet Propulsion	6 Hours

- **Introduction to Jet Propulsion**
  - Basic principles and classifications
  - Types of jet engines: turbojet, turbofan, turboprop, and ramjet
  - Thermodynamic cycles of jet engines
- **Thrust and Performance**

- Thrust equation and specific impulse
- Engine performance parameters
- Design considerations for various jet engines

Unit:5	Analysis of Jet Engines	7 Hours

- **Turbojet Engines**
  - Construction and working principles
  - Thermodynamic analysis and performance
- **Turbofan Engines**
  - Construction and working principles
  - Thermodynamic analysis and performance
  - Bypass ratio and its effect on performance
- **Other Jet Engines**
  - Turboprop and turboshaft engines
  - Ramjet and scramjet engines
  - Applications and future trends

Unit :6	Advanced Topics and Applications	6 Hours

- **Rocket Propulsion**
  - Principles of rocket propulsion
  - Types of rockets: solid, liquid, hybrid
  - Performance parameters and design considerations
- **Nozzle Design**
  - Convergent and convergent-divergent nozzles
  - Design criteria for subsonic, sonic, and supersonic flows
  - Non-ideal flow effects: shock waves and boundary layer interactions
- **Computational Methods in Gas Dynamics**
  - Introduction to CFD in gas dynamics
  - Governing equations and numerical methods

- Applications of CFD in jet propulsion systems

- **Current Trends and Research**
  - Advances in propulsion technologies
  - Environmental impacts and mitigation strategies
  - Future of gas dynamics and jet propulsion

Total Lecture Hours	**39 Hours**

Text books	
1	"Fundamentals of Gas Dynamics" by V. Babu
2	"Principles of Jet Propulsion and Gas Turbines" by N. A. Cumpsty
Reference Books	
1	"Compressible Fluid Flow" by Patrick H. Oosthuizen and William E. Carscallen
2	Mechanics and Thermodynamics of Propulsion" by Philip G. Hill and Carl R. Peterson
3	Hypersonic and High Temperature Gas Dynamics" by John D. Anderson Jr.
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	http://link.springer.com/openurl?genre=book&isbn=978-1-4613-6193-0
2	https://onlinelibrary.wiley.com/doi/book/10.1002/9780470168042
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2	https://nptel.ac.in/courses/112/104/112104121

VII SEMESTER
22ME774 : PE:VII:- Industry 4.0

Course Outcomes:

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

1. Articulate the recent manufacturing trends related to Industry 4.0 and its implementation
2. Interpret concepts and basic framework necessary for smart manufacturing
3. Develop understanding about harnessing smartness into manufacturing processes from the data
4. Able to find the applications of all the areas in day to day life.

Unit:1	Industry 4.0:	8 Hours

- Concept, Globalization and emerging issues, The Fourth Revolution, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation,
- Future of Works and Skills for Workers in the Industry 4.0 Era. LEAN manufacturing, Smart and connected business perspectives, Smart factories.

[CO-I]

Unit:2	Road to Industry 4.0:	7 Hours

- Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC,
- Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics. **[CO-II]**

Unit:3	Related Disciplines, System, Technologies for enabling Industry 4.0:	8 Hours

- Cyber physical Systems, key components, ISA-95 architecture, CPS-5C architecture, Industrial Processes, Industrial Internet Systems. Robotic Automation and Collaborative Robots, Support System for Industry 4.0, CNC and FMS system integration.
- Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis and Concept of Digit Twin. **[CO-II]**

Unit:4	Communication and IoT Platform:	7 Hours

- Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, Ether CAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server.
- Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers. **[CO-III]**

Unit:5	Smart Manufacturing:	8 Hours

- "Smart Manufacturing", really and how does it differ from conventional/legacy manufacturing-Smart Manufacturing Processes- Three Dimensions: Demand Driven and Integrated Supply Chains; Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations); Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG) lightweight objects, and Guidelines for making functionally gradient objects.
- 3D printing technologies, selection of material and equipment, develop a product using 3D printing in Industry 4.0 environment **[CO-III]**

Unit:6	Smart Applications:	7 Hours

- Industry 4.0 integration with manufacturing systems, Application domains: Manufacturing, Healthcare, Education, Aerospace, Defense, Agriculture, Transportation and Logistics. Case studies on IoT cloud system in manufacturing and other domains. **[CO-IV]**

Total Lecture Hours	**45 Hours**

Text books:	
1	A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.
2	N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.
3	M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.
4	Cloud Based Cyber-Physical Systems in Manufacturing, 2019, Wang L, and Vincent W X, Springer.
5	Digital Twin Driven Smart Manufacturing, 2019, Tao F, Zhang M, and Nee A Y C, Academic Press.
Reference Books:	
1	Industrial Internet of Things – Cyber manufacturing Systems, 2017, Jeschke S, Brecher C, Song H, and Rawat D B,, Springer
2	Designing the Internet of Things, 2013,1st edition, A. McEwen and H. Cassimally, Wiley
YCCE e- library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
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MOOCs Links and additional reading, learning, video material	
1	https://nptel.ac.in/courses/106105195
2	https://onlinecourses.nptel.ac.in/noc23_me71/preview

Online resources:	
1	http://www.mqtt.org
2	https://opcfoundation.org/about/opc-technologies/opc-ua/
3	https://www.profibus.com/pi-organization/about-pi/organization-communitu/
4	https://www.ethercat.org/default.htm
5	https://www.techtitute.com/in/engineering/professional-master-degree/master-digital-transformation-industry-4-0?gclid=EAIaIQobChMIutyQhK_y_wIVynR9Ch0tQgJfEAMYASAAEgJ0QvD_BwE
6	Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015
7	Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Thigs", Springer Link, 2016 4. Michahelles,
8	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
9	"Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978- 3-642-19157-2, Springer.
10	Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821-140-7, Willy Publications.
11	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
12	W. Botton, "Programmable Logic Controllers", Fourth Edition, Elsevier, 2006
13	P. Juahs, K. Molnar, "Key Components of the Architecture of Cyber-physical manufacturing systems", International Scientific Journal "Industry 4.0", 2017, issue 5, 205- 207
14	Jen-Ruey Jiang, "An improved cyber-physical systems architecture for Industry 4.0 smart factories", Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15
15	https://archive.nptel.ac.in/content/syllabus_pdf/106105195.pdf
16	https://study.iitm.ac.in/ds/course_pages/BSMS4001.html

VII SEMESTER
22ME775 : PE VII : Micro Electro Mechanical Systems (MEMS)

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Explain the role of MEMS in various industries such as automotive, medical, and telecommunications.
- Utilize photolithography, etching, and deposition techniques to fabricate simple MEMS structures.
- Analyze data from MEMS devices to understand their response to different stimuli.
- Evaluate the impact of material selection, fabrication techniques, and environmental factors on device performance.

Unit I: Introduction	**(7 Hrs.)**
Microsystems versus MEMS, Micro fabrication, Smart Materials, Structures and Systems, Integrated Microsystems, Applications of Smart Materials and Microsystems	
Unit II: Micro Sensors, Actuators, Systems and Smart Materials	**(8 Hrs.)**
Silicon Capacitive Accelerometer, Piezoresistive Pressure Sensor , Conductometric Gas Sensor, An Electrostatic Comb-Drive, A Magnetic Micro relay, Portable Blood Analyzer , Piezoelectric Inkjet Print Head, Micromirror Array for Video Projection Smart Materials and Systems	
Unit III: Micro Fabrication Technique	**(8 Hrs.)**
Silicon as a Material for Micromachining, Thin-Film Deposition, Lithography, Etching, Silicon Micromachining Specialized Materials for Microsystems, Advanced Processes for Micro fabrication	
Unit IV: Modeling of Solids in Microsystems	**(6 Hrs.)**
The Simplest Deformable Element: A Bar, Transversely Deformable Element: A beam, Energy Methods for Elastic Bodies, Heterogeneous Layered Beams, Bimorph Effect, Residual Stresses and Stress Gradients, Poisson Effect and the Anticlastic Curvature of Beams, Torsion of Beams and Shear Stresses, Dealing with Large Displacements, In- Plane Stresses	
Unit V: Finite Element Method	**(8 Hrs.)**
a. Need for Numerical Methods for Solution of Equations Variational Principles, Finite Element Method, Finite Element Model for Structures with Piezoelectric Sensors and Actuators, Analysis of a Piezoelectric Bimorph Cantilever Beam	

b. Modeling of Coupled Electromechanical Systems Electrostatics, Coupled Electromechanics: Statics and Stability and Pull-In Phenomenon, Dynamics, Squeezed Film Effects in Electromechanics	
Unit VI: Electronics Circuits and Control for Micro and Smart Systems	**(8 Hrs.)**
a. Semiconductor Devices, Electronics Amplifiers, Practical Signal Conditioning Circuits for Microsystems, Circuits for Conditioning Sensed Signals, Introduction to Control Theory, Implementation of Controllers **b. Integration of Micro and Smart Systems** Integration of Microsystems and Microelectronics, Microsystems Packaging	
Total Lecture	**45 Hours**

Textbooks:	
1.	**Micro And Smart Systems** by G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre : Wiley, India (2010)

Reference Books:	
1.	**Smart Material Systems and MEMS**: Design and Development Methodologies: Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan , John Wiley & Sons Ltd,
2.	**The MEMS Handbook:** Edited by Mohamed Gad-el-Hak, University of Notre Dame, CRC Press LLC

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1	https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUKU%20INDUSTRIAL%20ENGINEERING/Industrial%20Engineering%20and%20Production%20Management%20by%20Martand%20T.%20Telsang%20(z-lib.org).pdf
2	https://ycce.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=MCGRAWHILL1_07022023_661

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc20_mg19/
2.	https://nptel.ac.in/courses/105106213
3	http://www.digimat.in/nptel/courses/video/110107130/L25.html

VII SEMESTER
22ME776 : PE VII : AI in Manufacturing

Course Outcomes :

Upon successful completion of the course, the students will be able to;

- Implement AI Techniques in Manufacturing Scenarios.
- Analyze Manufacturing Data for Insights.
- Assess the Effectiveness of AI Solutions.
- Design Innovative AI Solutions

Unit I: Introduction to AI in Manufacturing (7 Hrs.)

- **Overview of AI and Manufacturing**
  - Definition and scope of AI in the context of manufacturing.
  - Historical development and evolution of AI in the manufacturing industry.
- **Key Concepts and Technologies**
  - Basics of machine learning, deep learning, and neural networks.
  - Introduction to data science and big data analytics.
- **AI-driven Manufacturing Processes**
  - Automation and robotics.
  - Predictive maintenance and quality control.

Unit II: Machine Learning Applications in Manufacturing (8 Hrs.)

- **Supervised Learning Techniques**
  - Regression, classification, and their applications in manufacturing.
  - Case studies on predictive maintenance and quality assurance.
- **Unsupervised Learning Techniques**
  - Clustering, anomaly detection, and their applications.
  - Case studies on fault detection and pattern recognition.
- **Reinforcement Learning**

- Basics of reinforcement learning and its potential in manufacturing.
- Case studies on robotics and automated process optimization

Unit III: Robotics and Automation	**(8 Hrs.)**

- **AI in Robotics**
  - Introduction to industrial robots and their applications.
  - Machine vision and its role in robotics.
- **Collaborative Robots (Cobots)**
  - Working principles of cobots.
  - Human-robot interaction and safety considerations.
- **Robotic Process Automation (RPA)**
  - RPA in manufacturing: scope and benefits.
  - Case studies on RPA implementations.

Unit IV: Predictive Maintenance and Quality Control	**(6 Hrs.)**

- **Predictive Maintenance**
  - Techniques for predictive maintenance using AI.
  - Benefits and challenges of implementing predictive maintenance.
- **Quality Control**
  - AI techniques for real-time quality control.
  - Case studies on defect detection and process optimization.
- **Data Collection and Analysis**
  - Sensor technologies and IoT in data collection.
  - Data preprocessing and feature engineering for predictive models.

Unit V: Supply Chain Optimization	**(8 Hrs.)**

- **AI in Supply Chain Management**

- Demand forecasting and inventory optimization.
- Logistics and transportation optimization.

- **Intelligent Scheduling and Planning**
  - AI algorithms for production scheduling.
  - Case studies on optimizing supply chain networks.

- **Blockchain and AI**
  - Integration of blockchain technology with AI for supply chain transparency.
  - Use cases and industry applications.

Unit VI: Future Trends and Ethical Considerations	**(8 Hrs.)**

- **Emerging Trends in AI and Manufacturing**
  - Smart factories and Industry 4.0.
  - Edge computing and its impact on manufacturing.

- **Ethical and Societal Implications**
  - Ethical considerations in deploying AI in manufacturing.
  - Workforce implications and the future of jobs in manufacturing.

- **Case Studies and Real-world Applications**
  - In-depth analysis of successful AI implementations in manufacturing.
  - Lessons learned and best practices.

Total Lecture	**45 Hours**

Textbooks:	
1.	"Artificial Intelligence: A Guide for Thinking Humans" by Melanie Mitchell
2	"Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Reference Books:	
1.	"Industrial AI: Applications with Sustainable Performance" by Jay Lee, Behrad Benyamin, and

	Chunsheng Zhou
2.	"The Fourth Industrial Revolution" by Klaus Schwab

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUKU%20INDUSTRIAL%20ENGINEERING/Industrial%20Engineering%20and%20Production%20Management%20by%20Martand%20T.%20Telsang%20(z-lib.org).pdf
2	https://ycce.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=MCGRAWHILL1_07022023_661

MOOCs Links and additional reading, learning, video material	
1.	https://onlinecourses.nptel.ac.in/noc20_mg19/
2.	https://nptel.ac.in/courses/105106213
3	http://www.digimat.in/nptel/courses/video/110107130/L25.html

VII SEMESTER
22ME777 : PE VII : Lean Manufacturing & Six Sigma

Course Outcomes :
Upon successful completion of the course, the students will be able to; 9. Understand the basic concepts of six sigma. 10. Understand the various statistical quality control methods and its relevance in six sigma.. 11. Understand the basic concepts of lean manufacturing and Cellular manufacturing. 12. Apply 5s , TQM and acceptance sampling tools for lean manufacturing .

Unit I: Introduction to Six-Sigma	**(7 Hrs.)**
Probabilistic models-Six Sigma measures-Yield-DPMO-Quality Level-Reliability function using Six Sigma-MTTF using Six Sigma-Maintenance free operating period- Availability using Six-Sigma Point availability-Achieved availability-Operational Availability-Examples. (CO 1)	
Unit II: The Elements of Six Sigma and their Determination	**(8 Hrs.)**
The Quality Measurement Techniques: SQC, Six Sigma, Cp and Cpk- The Statistical quality control (SQC) methods-The relationship of control charts and six sigma-The process capability index (Cp)Six sigma approach-Six sigma and the 1.5 shift-The Cpk Approach Versus Six Sigma-Cpk and process average shift- Negative Cpk-Choosing six sigma or Cpk-Setting the process capability index-Examples. (CO 2)	
Unit III: Introduction To Lean Manufacturing	**(8 Hrs.)**
Introduction To Lean Manufacturing Conventional Manufacturing versus Lean Manufacturing — Principles of Lean Manufacturing Basic elements of lean manufacturing — Introduction to LM Tools. (CO 3)	
Unit IV: Cellular Manufacturing, JIT, TPM	**(6 Hrs.)**
Cellular Manufacturing — Types of Layout, Principles of Cell layout, Implementation. JIT Principles of JIT and Implementation of Kanban. TPM — Pillars of TPM, Principles and implementation of TPM. (CO 3)	
Unit V: Tools for lean	**(8 Hrs.)**
Set Up Time Reduction, TQM, SS, vsM 10 6Hrs Set up time reduction — Definition, philosophies and reduction approaches. TQM — Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles. OC Curve for attributes. (CO 4)	
Unit VI: Acceptance Sampling	**(8 Hrs.)**
Acceptance Sampling: Key Concept-Design of Acceptance Sampling Plans for Attributes , Design of Acceptance Sampling Plans for Variables (analytical treatement). (CO 4)	
Total Lecture	**45 Hours**

Textbooks:	
1.	U Dinesh Kumar, Crocker, Chitra and Harithe Saranga, Reliability and Six Sigma, Springer Publishers.
2.	Sung H. Park, Six Sigma for Quality and Productivity Promotion, Asian Productivity Organization
3	Howard S. Gitlow and David M. Levine, Six Sigma for Green Belts and Champions, Pearson Education, Inc.
4	T. M. Kubiak and Donald W. Benbow, The Certified Six Sigma Black Belt Handbook, Pearson Publication

Reference Books:	
1.	Sammy G. Shina, Six Sigma for Electronics Design and Manufacturing, McGraw-Hill.
2.	Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & sons, 2003.
3.	Mikell P. Groover (2002) Automation, Production Systems and CIM.
4.	Rother M. and Shook J, 1999 _Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, Brookline, MA.
5	Forrest W. Breyfogle III, Implementing Six Sigma, John Wiley & Sons, INC

YCCE e-library book links [ACCESSIBLE FROM COLLEGE CAMPUS]	
1	https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/BUKU%20INDUSTRIAL%20ENGINEERING/Industrial%20Engineering%20and%20Production%20Management%20by%20Martand%20T.%20Telsang%20(z-lib.org).pdf
2	https://ycce.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=MCGRAWHILL1_07022023_661

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3	http://www.digimat.in/nptel/courses/video/110107130/L25.html

VII Semester
ME – Project Phase-2

Course Code: ME-	Project Phase-2			L= 3	T=0	P=0	Credits=5
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total		ESE Duration
			60	40	100		10 Hrs

COURSE OUTCOME

On successful completion of the course students will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation and solution.
- Design engineering solutions to complex problems utilizing a systems approach including ability to work in a team.
- Communicate effectively to discuss and solve engineering problems.

The group of students will continue to work for the project allotted previously and will submit a project report based on their studies. Evaluation will be done continuously and viva voce conducted at the end of the semester.

VIII SEMESTER

22ME801__Industrial Internship

VIII SEMESTER

22ME802__Extracurricular Activity Evaluation

Course Outcomes :

Upon successful completion of the course the students will be able to

1. Develop leadership through the engagement of collaboration, and then put it into action to complete the task
2. Employ with a diverse range of individuals
3. Operate to the advancement of society and the identification of health-related problems
4. Produce independently as well as member of a team in order to achieve established goals

Due credits will be given to the students based on their performance and involvement in different extra and co-curricular activities conducted within the college or by other organizations/ institutions. Due credit will also be given to the student if they are successful in different competitive examinations conducted by different organizations. The guidelines as given in academic regulations will be followed for evaluation.