Mech./7281/0268/23

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering

BOARD OF STUDIES (BOS) PROCEEDING

DEPARTMENT OF MECHANICAL ENGINEERING

(MEETING DATED 2nd June 2023)

CONTENTS

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

MINUTES OF MEETING OF BOARD OF STUDIES (BoS)

An online meeting of following members (external and internal) was held on 2nd June, 2023 at 11:00 AM through online mode (Google Meet Link **meet.google.com/qcw-zqip-txr**)

Following members were present:

(1)	Dr. M.K. Gaur	Head of the Department and Chairman of the Committee
(2)	Dr. Prashant Kumar Jain	Professor, IIITDM, Jabalpur, RGPV Nominee
(3)	Dr. Mukul Shukla	Professor, MNNIT, Allahabad , AC Nominee
(4)	Dr. A. K. Tiwari	Professor, NIT, Raipur, AC Nominee
(5)	Er. Anil Gupta	CEO, APN Technologies, New Delhi, Industry Expert
(6)	Er. Abhishek Khare	Aerodynamics Engineer Calidus, LLC,Abu Dhabi, Alumni
(7)	Er. Amit Lahariya	CPS Leader, Cummins India Pvt. Ltd., Alumni
(8)	Dr. Pratesh Jayaswal	Member
(9)	Dr. Manish Ku. Sagar	Member
(10)	Dr. C. S. Malvi	Member
(11)	Mr. R. P. Kori	Member
(12)	Mr. Vedansh Chaturvedi	Member
(13)	Dr. Jyoti Vimal	Member
(14)	Mr. Sharad Agrawal	Member
(15)	Mr. Vaibhav Shivhare	Member
(16)	Dr. Amit Aherwar	Member
(17)	Mr. Bhupendra K Pandey	Member
(18)	Dr. Nitin Upadhyay	Member
(19)	Dr. Surendra Ku. Chourasiya	Member
(20)	Dr. Gavendra Norkey	Member
(21)	Dr. Dinesh Kumar Rathore	Member
(22)	Vansh Vandhe	Student Member, I Year
(23)	Deepak Singh	Student Member, II year
(24)	Anshita Verma	Student Member, III Year
(25)	Piyush Soni	Student Member, III Year
(26)	Alok Sharma	Student Member, III Year

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

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Agenda of the BoS Meeting

(Approved by Academic Development Cell of the institute - BoS Meeting Scheduled on 2nd June 2023)

Instructions for preparing BoS Proceedings

(All information is to be uploaded on the webpage under suitable heading (such as Board of Studies) and separate links to be provided for each category mentioned below)

Minutes should have a summary cover page mentioning all the significant changes made in the following given format

Courses where revision was carried out*

(Course/subject name)	Course Code	Year/ Date of introduction	Year/Date of revision	Percentage of content added or replaced	Agenda Item No.	Page No.	Link of relevant documents/minutes
Industrial Engineering	190511/120511	2019	2/6/2023	10%	ME 8		https://drive.google.com/file/d/1mAQ2UPiIlov5ckYIq3oz_LXbSjDx_qRXp/view?usp=sharing
Mechanics of Materials	2190331/2120331	2019	2/6/2023	10%	ME 12		

Courses focusing on employability/entrepreneurship/ skill development*

(Course/subject name)	Course Code	Activities/contents which have a bearing on increasing skill and employability	Agenda Item No.	Page No.	Link of relevant documents/minutes
Advanced Production Technology	120731	Latest technologies and coding in manufacturing	ME 3		https://drive.google.com/file/d/1wps4twUKBKoGAjwRK7PA0p1emTs_YXFa/view?usp=drive_link
Metrology, Measurement and Control	120732	Advanced measurement tools	ME 3		
Hybrid Electric Vehicles	190732	Concept of electric concept in vehicles	ME 3		
Automotive Maintenance Lab	190715	Hands on practice on vehicle maintenance	ME 3		
Reliability and Vibration Lab	120715	Fault detection in bearings and remedies	ME 3		
Foundation of Computational Fluid Dynamics	120761	Analysis of fluid flow through simulation	ME 4		
Advanced Machining Processes	120763	Latest machining processes and their application	ME 4		
Fundamentals of Additive Manufacturing Technologies	120764	Additive manufacturing concepts with applications	ME 4	-	

New Courses added*

	(Course/subject name)	Course Code	Activities/contents which have a bearing on increasing skill and employability	Agenda Item No.	Page No.	Link of relevant documents/minutes
1.	Fundamentals Of Additive Manufacturing Technologies	120764	Additive manufacturing concepts with applications	ME 4		https://drive.google.com/file/d/1CVEs85ikubOumZA3GI5jX3YIT9NCL4/view?usp=drive_link
	Energy Conservation And Waste Heat Recovery	120765	Methods of energy conservation and concepts of heat recovery methods	ME 4		
	Work system Design	120766	Ergonomics design concept	ME 4		
	Powder Metallurgy	190763	Latest methods of metal powder manufacturing	ME 4		
	Sustainable Power Generation Systems	190764	Different techniques of power generations	ME 4		
	Supply Chain Management	910210	Logistics/materials handling concepts in industries	ME 4		

Feedback on curriculum received from stakeholders: Analysis& ATR*

Stakeholder	Student	Faculty	Alumni	Employer
No. of responses	150	10	30	67
Link of Analysis	https://docs.google.com/spreadsheets/d/1PIKZ7qMoqvh24feggH6YolJKhCPuHSMHZ/edit?usp=sharing&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1M1I2P678ind-vTFgITTIEWyITQJZZZo/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1VIfXjA_FK8dY4WTqHdUsNqluAAuFJGFy/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1KRFNkdIIWKgrydIIKrpgeRxqlQRxFAHAA/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true
ATR Link	https://docs.google.com/document/d/13I1emIPtC0SXcuOnpdnbwLf44I2OV03x/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/document/d/13I1emIPtC0SXcuOnpdnbwLf44I2OV03x/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/document/d/13I1emIPtC0SXcuOnpdnbwLf44I2OV03x/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/document/d/13I1emIPtC0SXcuOnpdnbwLf44I2OV03x/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true
Link showing Excel sheet of Google Form details of stakeholders	https://docs.google.com/spreadsheets/d/1PIkZ7qMoqvh24feggH6YolJKhCPuHSMHZ/edit?usp=sharing&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1M1I2P678ind-vTFgITTIEWyITQJZZZo/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1VIfXjA_FK8dY4WTqHdUsNqluAAuFJGFy/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1KRFNkdIIWKgrydIIKrpgeRxqlQRxFAHAA/edit?usp=drive_link&ouid=110499483831438724131&rtpof=true&sd=true

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	** Separate page(s) for each of the above four points. Agenda point wise minutes to be appended with each point and a separate link to be given in the appropriate column for each point*

BoS Agenda Items

Item ME1

To confirm the minutes of previous BoS meeting held in the month of December 2022

The minutes of the last BoS held on 14th December 2022 were confirmed. The BoS Minutes were presented & approved in Academic Council Meeting held on 23rd December 2022.

Item ME2

To prepare and finalize the **scheme structure of B.Tech. VII Semester** with the provision of *Three Departmental Electives (DEs)***(in which two Departmental Electives to be offered in online mode with credit transfer)***and one Open Category (OC) Course for the batch admitted in 2020-21.*

S.No.	Subject Code	Category	Subject Name & Title
1.	DE	DE	Departmental Elective-2 (DE-2)
2.	DE*	DE	Departmental Elective -3 (DE-3)
3.	DE*	DE	Departmental Elective -4 (DE-4)
4.	OC	OC	Open Category -2 (OC-2)
5.	190715/120715	DLC	Automotive Maintenance Lab/Reliability and Vibration Lab (DLC-6)
6.	190716/120716	DLC	Summer Internship Project-II (Institute Level) (Evaluation
7.	190717/120717	DLC	Creative Problem Solving (DLC-7)

Item ME3

To prepare and finalize the syllabus of courses to be offered ***(for the batch admitted in 2020-21)***under ***Departmental Elective (DE) Course***(in traditional mode) for B. Tech. ***VII Semester*** along with their COs

Mechanical Engineering			Automobile Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120731	Advanced Production Technology	1	190731	Vehicle Dynamics
2	120732	Metrology, Measurement and Control	2	190732	Hybrid Electric Vehicles
3	120733	Total Quality Management			

Item ME4

To propose the list of courses which the students can opt from SWAYAM/NPTEL/MOOC based Platforms, to be offered in ***online mode under*** **Departmental Elective (DE)**Courses, with credit transfer in the B. Tech. ***VII Semester under*** the flexible curriculum (***for the batch admitted in 2020-21)***

Mechanical Engineering			Automobile Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120761	Foundation of Computational Fluid Dynamics	1	190761	Farm Machinery
2	120762	Introduction to Composites	2	190762	Introduction to Mechanical Vibration
3	120763	Advanced Machining Processes	3	190763	Powder Metallurgy
4	120764	Fundamentals of Additive Manufacturing Technologies	4	190764	Sustainable Power Generation Systems
5	120765	Energy Conservation And Waste Heat Recovery			
6	120766	Work system Design			

Item ME5

To prepare and finalize the syllabus of courses to be offered ***(for the batch admitted in 2020-21)*** under the ***Open Category (OC) Courses***(in traditional mode) for B. Tech. ***VII semester*** students of other departments along with their COs

Open Category (OC-2)		
S.No.	Subject Code	Subject Name
1	910208	Solar Energy
2	910209	Maintenance Engineering
3	910210	Supply Chain Management

Item ME6

To prepare and finalize the Experiment list/ Lab manual for Departmental Laboratory Course (DLC) to be offered in B. Tech. VII semester ***(for the batch admitted in 2020-21)***

Automotive Maintenance (190715)	Reliability and Vibration Lab (120715)
1. Study and layout of an automobile repair, service and maintenance shop. 2. Study and preparation of different statements/records required for the repair and maintenance works. 3. Cylinder reboring – checking the cylinder bore, Setting the tool and reboring. 4. Valve grinding, valve lapping - Setting the valve angle, grinding and lapping and checking for valve leakage 5. Calibration of fuel injection pump 6. Minor and major tune up of gasoline and diesel engines. 7. Study and checking of wheel alignment - testing of camber, caster. 8. Brake adjustment and Brake bleeding. 9. Battery testing and maintenance	1. Determination of Critical Speed in Whirling of Shafts. 2. Determination of Natural Frequency in Longitudinal Vibrating System. 3. Determination of Natural Frequency in Torsional Vibration System. 4. To verify the relation of compound pendulum & to determine the radius of gyration 5. To study the undamped free vibration of spring mass system. 6. To study the forced vibration of simply supported beam for different damping. 7. Undamped tensional vibrations of single and double rotor system. 8. To study the damped torsional vibration of single rotor system and to determine the damping coefficient. 9. To study the forced damped vibration of spring mass system. 10. Study the machine fault diagnostic system based on vibration analysis.

Item ME7

To propose the list of "Additional Courses" which can be opted for getting an

(i) Honours (for students of the host department)

(ii) Minor Specialization (for students of other departments)

[These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the B.Tech. ***VII semester students*** *(for the batch admitted in 2020-21)] and for* B.Tech. ***V semester*** *(for the batch admitted in 2021-22)]*

Sem	V (for the batch admitted in 2021-22)	VII (for the batch Admitted in 2020-21)
Honours Course Name	1. Principle of Hydraulic Machines and System Design (12 Weeks) 2. System design for sustainability (12 Weeks) 3. Manufacturing Systems Technology Part I & II (12 Weeks)	1.Fundamentals of Artificial Intelligence (12 Weeks) 2. Rapid Manufacturing (12 Weeks) 3. Heat Exchangers: Fundamentals and Design Analysis (12 Weeks)

Sem	V (for the batch admitted in 2021-22)	VII (for the batch Admitted in 2020-21)
Minor Course Name	1. Basics of Materials Engineering (12 Weeks) 2. Fluid Mechanics (12 Weeks)	1. Engineering Metrology (12 Weeks) 2. Applied Thermodynamics for Engineers (12 Weeks)

Item ME8

To prepare and recommend the ***scheme structure of B.Tech. V Semester under*** the flexible curriculum (for the *Batch admitted in 2021-22)*

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S.No.	Automobile Engineering			Mechanical Engineering		
	Subject Code	Category	Subject Name & Title	Subject Code	Category	Subject Name & Title
1.	190519	MC	Data Science	120519	MC	Data Science
2.	190511	DC	Industrial Engineering (DC-9)	120520	DC	Theory of Machines – II (DC-9)
3.	190513	DC	Heat and Mass Transfer (DC-10)	120511	DC	Industrial Engineering (DC-10)
4.	190514	DC	Design of Machine Elements (DC-11)	120513	DC	Heat and Mass Transfer (DC-11)
5.	190520	DC	Automotive Chassis (DC-12)	120515	DC	Machine Design (DC-12)
6.	190516	DLC	Minor Project-I	120516	DLC	Minor Project-I**
7.	190517	Seminar/ Self-Study	Self-learning/Presentation (SWAYAM/NPTEL/ MOOC)*	120517	Seminar/ Self-Study	Self-learning/Presentation (SWAYAM/NPTEL/ MOOC)*
8.	200xxx	CLC	Novel Engaging Course (Informal Learning)	200XXX	CLC	Novel Engaging Course (Informal Learning)
9.	190518	DLC	Summer Internship Project-II (Evaluation)	120518	DLC	Summer Internship Project-II (Evaluation)

Item ME9

To prepare and recommend the syllabi for all ***Departmental Core (DC) Courses*** of B. Tech. ***V Semester (for the batch admitted in 2021-22)*** under the flexible curriculum along with their COs.

Automobile Engineering			Mechanical Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	190511	Industrial Engineering	1	120511	Industrial Engineering
2	190513	Heat and Mass Transfer	2	120513	Heat and Mass Transfer
3	190514	Design of Machine Elements	3	120515	Machine Design.
4	190520	Automotive Chassis	4	120520	Theory of Machines-II

Item ME10

To prepare and recommend the suggestive Experiment list/ Lab manual and list of projects which can be assigned under the 'Skill based mini-project' category in various laboratory component based courses to be offered in B. Tech. V Semester (for the batch admitted in 2021-22)

190520: Automotive Chassis	120515: Machine design	190514: Design of Machine Elements	120520: ToM-II
1. Study and Construction of physical model of Chassis layout and its main components. 2. Structural analysis of Chassis of a vehicle and its main components through Design tools. 3. Design, Calculation and simulation of Rack and Pinion mechanism to steer a vehicle using design tools. 4. Study and Construction of physical model of contactless braking system. 5. Study and Structural analysis of Shock absorbers for two-wheeler and four-wheeler. 6. Assembly and dismantling of automotive engine and clutch.	1. Finite element analysis of Helical compression spring for three wheelers automotive suspension 2. To prepare wooden model Multi Leaf spring. 3. To prepare wooden model of Gear box. 4. To prepare wooden model of Bearing. 5.Stress analysis on Spur Gear and durability study by FEA	1. FEA of lap joint based on various geometrical parameters to study the behavior of weld strength 2. Simulation of welding to study residual stress and distortions 3. Analysis of composite multi leaf spring using ANSYS 2020 R1 4. Heat Transfer analysis for different materials of ball bearing using ANSYS 2020 R1 5. Numerical analysis of Modified tooth in Spur Gear for increasing the performance by reducing the assembly errors and gear slippage in the axial direction during dynamic loading	1.Investigation of gyroscopic couple for self-balancing vehicle 2. Understanding of balancing and alignment. 3. Development of various toy mechanism 4.Understanding of Gear based quick return mechanism. 5.Investigation and understanding of geared cycle. 6.Understanding of gear mechanism used in watch. 7. Design of easy (make/use) cycle. 8.Working model of epicyclical gear train. 9.Investigation and understanding of sports cycle.

Item ME11

To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered ***(for the batch admitted in 2021-22)*** in online mode under ***Self-Learning/ Presentation***, in the B. Tech. ***V Semester***

S.No.	Name of Subject	Code	Week
1.	Foundations of Cognitive Robotics	120517/190517(i)	4
2.	Principles Of Vibration Control	120517/190517(ii)	4
3.	Welding of Advanced High Strength Steels for Automotive Applications	120517/190517(iii)	4

Item ME12

To review, prepare, finalize and recommend the ***Scheme & Syllabi (along with the Course Outcomes) of III semester*** **B. Tech. programmes (for the batch admitted 2022-23 Session)**

S.No.	Automobile Engineering			Mechanical Engineering		
	Subject Code	Category	Subject Name & Title	Subject Code	Category	Subject Name & Title
1.	2100025	BSC	Engineering Mathematics-II	2100025	BSC	Engineering Mathematics-II
2.	2190331	DC	Mechanics of Materials	2120331	DC	Mechanics of Materials
3.	2190332	DC	Automotive Engines	2120332	DC	Theory of Machines –I
4.	2190333	DC	Metal Cutting and Machine Tools	2120333	DC	Metal Cutting and Machine Tools
5.	2190334	DC	Fluid Mechanics & Hydraulic Machines	2120334	DC	Fluid Mechanics and Hydraulic Machines
6.	2190335	DLC	Software lab	2120335	DLC	Software lab
7.	2190336	DLC	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)	2120336	DLC	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)
8.	200XXX	CLC	Novel Engaging Course (Informal Learning)	200XXX	CLC	Novel Engaging Course (Informal Learning)
9.	2190337	DLC	Summer Internship Project–I (Institute Level) (Evaluation)	2120337	DLC	Summer Internship Project–I (Institute Level) (Evaluation)

Item ME13

To review, prepare, finalize and recommend the list of experiments/ Lab manual and skill based mini projects for various laboratory courses to be offered in III Semester ***(for the batch admitted in 2022-23)***.

2190332:Automotive Engine	2120332: ToM-I	2120334/2190334: FMHM
1. Engaging and disengaging engine from transmission through clutch using scrap engine material. 2.To prepare wooden model Connecting rod. 3.To prepare wooden model piston and piston pin. 4.To prepare a model showing the transmission system of two wheelers. 5.To prepare wooden model crank shaft.	1.Design and Fabrication of a Universal Coupling (Hooke's Joint) 2.Design and Fabrication of Agricultural Cutter Using 4 Bar mechanism. 3.Design and Fabrication of Air Compressor Using Crank and Slotted Link Mechanism 4.Design and Fabrication of Industrial Conveyor Using Four Bar Mechanism 5.Design and Fabrication of sliding RAM by using quick return mechanism.	1.Project to calculate the Meta centric height for different objects. 2.Project to define the concept of forced vortex and free vortex. 3.Project to demonstrate the working of Air Impulse Turbine. 4.Project to show the meaning of Hydrostatic Forces in Plane surface. 5.Project to show the meaning of Hydrostatic Forces in curved surface.

Item ME14

To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered ***(for the batch admitted in 2022-23)*** in online mode under ***Self-Learning/ Presentation***, in the ***III Semester***

S.No.	Name of Subject	Code	Week
1.	Manufacturing Processes - Casting And Joining	2120336/2190336(i)	4
2.	Understanding Design	2120336/2190336(ii)	4
3.	Product Design and development	2120336/2190336(iii)	4

Item ME15

To Review, prepare and recommend the scheme structure, Syllabi (along with the Course Outcomes), list of experiments/ Lab manual and skill based mini projects for various laboratory courses of ***I semester*** **B. Tech. programmes (for the batch admitted in 2023-24 Session)**

S.No.	Mechanical/Automobile Engineering		
	Subject Code	Category	Subject Name
1.	2100011	BSC	Engineering Mathematics-I
2.	2160122	ESC	Computer Programming
3.	2100021	ESC	Basic Mechanical Engineering
4.	2100022	ESC	Basic Electrical and Electronics Engineering
5.	2100020	ESC	Basic Civil Engineering and Mechanics
6.	2120026	ESC	Basic Mechanical Engineering Lab

Item ME16	To review the CO attainments, to identify gaps and to suggest corrective measures for the improvement in the CO attainment levels for July-Dec 2022.
Item ME17	To review PO attainment of 2018-2022 batch, CO-PO mapping matrix with attainments and gap analysis
Item ME18	To prepare and recommend the syllabi of Mandatory Audit Course: Universal Human Values & Professional Ethics (UHVPE). (at institute level)
Item ME19	To review curricula feedback from various stakeholders, its analysis and impact **{Stakeholder feedback analysis must also contain an Action Taken Report (ATR) and the details/data of the stakeholders who have responded through GOOGLE form (such as Name, organization, mail id, phone no., if available) must also be shared along with the feedback of the alumni/employer}**
Item ME20	To review the Course Outcomes (COs) feedback of various courses, its analysis, and ATR (for July –Dec. 2022 semester)
Item ME21	To discuss and recommend the scheme structure & syllabi of PG Programme (M.E./M.Tech./MCA/MBA) along with their Course Outcomes (COs)
Item ME22	To recommend the scheme structure and Syllabus of Ph.D. Course Work (specific to Doctoral Research Scholars, if any)
Item ME23	Any other matter

S.No.	Subject Code	Subject Name & Title
1.	560111	Computational Techniques
2.	560112	Production Engineering- I
3.	560118	Maintenance Management
4.	DE-I	Elective-I
5.	OC-I	*Open Category Course -1 (OC-1)
6.	560120	Production Engineering Lab-I
7.	560121	$ Self Learning / Presentation

Apart from the above points, the following points were discussed/Suggested in meeting;

1. All syllabuses should have prelims written.
2. Subject offered by NPTEL should be advanced in nature.
3. More Open Category (OC) courses should be added.

Dr. Dinesh Kumar Rathore (BoS Member)

Dr. Gayendra Norkey (BoS Member)

Dr. Nitin Upadhyay (BoS Member)

Dr. Surendra Ku. Chourasiya (BoS Member)

Mr. B. K. Pandey (BoS Member)

Present
Dr. Amit Ahirwar (BoS Member)

Mr. V. Shivhare (BoS Member)

Mr. Sharad Agrawal (BoS Member)

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Dr. Jyoti Vimal
(BoS Member)

Mr. V. Chaturvedi
(BoS Member)

Mr. R. P. Kori
(BoS Member)

Dr. C. S. Malvi
(BoS Member)

Dr. M. K. Sagar
(BoS Member)

Dr. Pratesh Jayaswal
(BoS Member)

Online Present
Er. Amit Lahariya
(Alumni)

Online Present
Er. Abhishek Khare
(Alumni)

Online Present
Er. Anil Gupta
(Industry Expert)

Online Present
Dr. A. K. Tiwari
(AC Nominee)

Online Present
Dr. Mukul Shukla
(AC Nominee)

Online Present
Dr. Prashant Kumar Jain
(RGPV Nominee)

Dr. M. K. Gaur
(BoS Chairman)

03/8/2023.
DEAN (ACADEMICS)
M.I.T.S
GWALIOR

Item ME2	To prepare and finalize the **scheme structure of B.Tech. VII Semester** with the provision of *Three Departmental Electives (DEs)* **(in which two Departmental Electives to be offered in online mode with credit transfer)** *and one Open Category (OC) Course* ***for the batch admitted in 2020-21.***

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Department of Mechanical Engineering

Scheme of Evaluation

For batch admitted in Academic Session 2020-2021

B.Tech. (Mechanical Engineering) VII Semester

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	[iii]Mode of Exam	Duration of Exam
				Theory Slot				Practical Slot			MOOCs									
				End Term Evaluation		Continuous Evaluation		End Sem Exam	Continuous Evaluation		Assignment	Exam		L	T	P				
				End Sem.		Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project										
				End Term Exa.	[i]Proficiency in subject course															
1.	DE	DE	Departmental Elective-2 (DE-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	FP	2 hr
2.	DE*	DE	Departmental Elective -3 (DE-3)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ	3 hr
3.	DE*	DE	Departmental Elective -4 (DE-4)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ	3 hr
4.	OC	OC	Open Category -2 (OC-2)	50	10	20	20	-	-	-	-	-	100	2	1	-	3	Blended	FP	2 hr
5.	120715	DLC	Reliability and Vibration Lab (DLC-5)	-	-	-	-	60	20	20	-	-	100	-	-	2	1	Offline	SO	
6.	120716	DLC	Summer Internship Project-II (Institute Level) (Evaluation	-	-	-	-	60	-	-	-	-	60	-	-	4	2	Offline	SO	
7.	120717	DLC	Creative Problem Solving (DLC-7)	-	-	-	-	25	25	-	-	-	50	-	-	2	1	Offline	SO	
Total				100	20	40	40	145	45	20	50	150	610	11	1	8	16			
8.	1000005	MAC	Universal Human Values & Professional Ethics (UHVPE)	50	10	20	20	-	-	-	-	-	100	2	-	-	Grade	Online	MCQ	
Additional Courses for obtaining Honors/Minor Specialization by desirous students				Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization																

[i] proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

[ii]MCQ: Multiple Choice Question [iii]AO: Assignment + Oral [iii]PP: Pen Paper [iii]SO: Submission + Oral

* Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with Credit Transfer

DE-2 (Through Traditional Mode)			DE-3*			DE-4*			Open Category (OC-2)		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120731	Advanced Production Technology	1	120761	Foundation of Computational Fluid Dynamics	1	120764	Fundamentals Of Additive Manufacturing Technologies	1	910208	Solar Energy
2	120732	Metrology, Measurement and Control	2	120762	Introduction to Composites	2	120765	Energy Conservation And Waste Heat Recovery	2	910209	Maintenance Engineering
3	120733	Total Quality Management	3	120763	Advanced Machining Processes	3	120766	Work system Design	3	910210	Supply Chain Management

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	SIP	Theory			Lab	SIP	
Offline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
9	6	6	-	2	2	6	6	6	2	2	16
9	37.5	37.5	-	12.5	12.5	37.5	0	37.5	12.5	12.5	100

DEAN (ACADEMICS)
M.I.T.S
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MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)

Department of Mechanical Engineering

Scheme of Evaluation

B.Tech. (Automobile Engineering) VII Semester

For batch admitted in Academic Session 2020-2021

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam	Duration of Exam
				Theory Slot				Practical Slot			MOOCs									
				End Term Evaluation		Continuous Evaluation		End Sem Exam	Continuous Evaluation					L	T	P				
				End Sem.		Mid Sem. Exams.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project	Assignment	Exam								
				End Term Eval.	[1]Proficiency in subject /course														[2]Mode of Exam	
1.	DE	DE	Departmental Elective-2 (DE-2)	50	10	20	20	-	-	-	-	-	100	3	-	-	3	Blended	PP	2 hr
2.	DE*	DE	Departmental Elective -3 (DE-3)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ	3 hr
3.	DE*	DE	Departmental Elective -4 (DE-4)	-	-	-	-	-	-	-	25	75	100	3	-	-	3	Online	MCQ	3 hr
4.	OC	OC	Open Category -2 (OC-2)	50	10	20	20	-	-	-	-	-	100	2	1	-	3	Blended	PP	2 hr
5.	190715	DLC	Automotive Maintenance (DLC-6)	-	-	-	-	60	20	20	-	-	100	-	-	2	1	Offline	SO	
6.	190716	DLC	Summer Internship Project-II (Institute Level) Evaluation	-	-	-	-	60	-	-	-	-	60	-	-	4	2	Offline	SO	
7.	190717	DLC	Creative Problem Solving (DLC-7)	-	-	-	-	25	25	-	-	-	50	-	-	2	1	Offline	SO	
Total				**100**	**20**	**40**	**40**	**145**	**45**	**20**	**50**	**150**	**610**	**11**	**1**	**8**	**16**			
8.	1000008	MAC	Universal Human Values & Professional Ethics(UHVPE)	50	10	20	20	-	-	-	-	-	100	2	-	-	Grade	Online	MCQ	
Additional Courses for obtaining Honors/Minor Specialization by desirous students				**Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization**																

[1] proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

[2]MCQ: Multiple Choice Question [2]AO: Assignment + Oral [2]PP: Pen Paper [2]SO: Submission + Oral

* Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with Credit Transfer

DE-2 (Through Traditional Mode)			DE-3*			DE-4*			Open Category (OC-2)		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	190731	Vehicle Dynamics	1	190761	Farm Machinery	1	190763	Powder Metallurgy	1	910208	Solar Energy
2	190732	Hybrid Electric Vehicles	2	190762	Mechanism and Robot Kinematics	2	190764	Sustainable Power Generation Systems	2	910209	Maintenance Engineering
									3	910210	Supply Chain Management

Mode of Teaching						Mode of Examination					
Theory				Lab	SIP	Theory			Lab	SIP	Total Credits
Offline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
8	6	6	-	2	2	6	0	6	2	2	16
0	37.5	37.5	-	12.5	12.5	37.5	0	37.5	12.5	12.5	100

DEAN (ACADEMICS)
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Item ME3	To prepare and finalize the syllabus of courses to be offered ***(for the batch admitted in 2020-21)***under ***Departmental Elective (DE) Course***(in traditional mode) for B. Tech. ***VII Semester*** along with their COs

Departmental Elective (DE) category courses (DE-2)					
Mechanical Engineering			Automobile Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120731	Advanced Production Technology	1	190731	Vehicle Dynamics
2	120732	Metrology, Measurement and Control	2	190732	Hybrid Electric Vehicles
3	120733	Total Quality Management			

120731: Advanced Production Technology (for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Department Elective- DE 2	Advanced Production Technology	120731	L	T	P	Max.Marks-60
			3	-	-	Min.Marks-19
						Duration-2 hrs.

Course Objectives: To make the student understand:

1. the application of computers in various aspects manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity and reduces the unnecessary costs.
2. the fundamental of automation and brief history of robot configurations, sensors, end effectors, vision systems and to impart knowledge of various additive manufacturing Technologies for application to various industrial needs.

Pre-requisite: Manufacturing Processes, Metal cutting

Syllabus

UNIT-I FUNDAMENTALS OF NC, CNC & DNC MACHINES: Principles of numerical control, types of CNC machines, features of CNC systems, integration of CNC machines in CIM environment, Direct numerical control (DNC), Open loop system, Closed loop system.

UNIT-IICONSTRUCTIONAL FEATURES OF CNC MACHINES and PART PROGRAMMING: Features of CNC Machines such as Structure, Drive Mechanism, Main drive, feed drive, Spindle Motors, Axes motors, Tool magazines, ATC, Control systems, Feedback devices, Input media and coding formats. Manual part programming for Lathe, Drilling and Milling machines, Cutter diameters and Length compensation. Computer assisted part programming Languages APT, EXPAT, ADAPT, COMPACT. Computer numerical control, direct and distributed numerical control, adaptive control.

UNIT-III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS: - GT Part Families, Classification & coding, M/C Cell Design, Benefits of GT, FMS Workstations, Material Handling & Storage Systems, Computer Control System, Planning of FMS Analysis Methods. Basic Elements of an Automated system, Levels of Automation.

UNIT-IV INDUSTRIAL ROBOTICS: Industrial Robots and their applications for transformational and handling activities. Configuration and motions, robot classification and their performance capabilities, hardware of robots, Actuators, sensors and end effectors, selecting assembly machines Feeding and transfer of arts, applications of robots in manufacture and assembly.

UNIT-V ADDITIVE MANUFACTURING: Introduction and Basic Principles of Additive Manufacturing, Development of Additive Manufacturing Technology, Generalized Additive Manufacturing Processes, Photopolymerization Processes / Powder based system Processes / Extrusion-Based Systems, Material Jetting / Binder Jetting / Sheet Lamination/sintering Processes, Prototyping, Rapid Tooling, Applications of Additive Manufacturing, Comparison of Additive Manufacturing Methods.

Course Outcomes: After successful completion of this course students will be able to:

CO1 Illustrate the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion.

CO2 Demonstrate the machining operations, programming languages and its control system used for solving practical problems of automation based.

CO3 Compare the components of computer integrated manufacturing and integrate them in a coordinated manner.

CO4 Decide between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements.

CO5 Designing Flexible manufacturing cell after carrying out Group technology study, Automated Material Handling Systems, Automated Inspection Systems and finally creating FMS.

CO6 Knowledge in the broad spectrum of Production Engineering.

Text & References Books:

1. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI publication.
2. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
3. Computer control of machine tools by Koren Yoram, Tata McGraw Hill publication
4. Manufacturing Engineering And Technology by Serope Kalpakjian, PHI publication.
5. CAD/CAM/CIM by Bhupendra Gupta, Dhanpat Rai publication
6. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.
7. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.

120732: Metrology, Measurement and Control

(for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective –DE2	Metrology, Measurement and Control	120732	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2 hrs.

Course Objectives: To make the students to understand:
1. The types of errors, design of limit gauges and various comparative measurements.
2. The fundamentals of gears, thread measurements and measurements of surface finish.
3. Non-contact measurement techniques using optical methods and vision techniques.
4. Coordinate metrology and Form Measurement.
5. The use of control chart.

Prerequisite: Nil

Syllabus

Unit –I: General Concepts of Measurement; Definition-standards of measurement, errors in measurement, limit-gauging, various systems of limits, fits and tolerance, interchangeability, ISI and ISO system. basic principles and design of standards of measuring gauges, types of gauges and their design, accuracy and precision, calibration of instruments, principles of light interference, interferometer, measurement and calibration.

Unit –II: Linear and Angular Measurements; Slip gauges, micrometers, verniers, dial gauges, surface plates, comparators- mechanical, electrical, pneumatic and optical comparator, angular measuring instruments- sine bar, angle gauges, spirit level, autocollimators, clinometers; measurement of straightness, flatness and squareness.

Unit –III: Measurement of Surface Finish and Measuring Machines; Surface finish- definitions, types of surface texture, surface roughness measurement methods, comparison, profile-meters, pneumatic and replica, measurement of run out and concentricity, length bar measuring machine, optical projection, comparator, tool makers microscope.

Unit –IV: Metrology of Screw Threads and Gears; Internal/external screw thread, terminology, measurement of various elements of threads, thread micrometer method, two wire and three wire methods; gear terminology, measurement of various elements, constant chord method, base tangent method, plug method; gear tester, gear tooth measurement; rolling gear tester.

Unit –V: Computer Aided and Laser Metrology; Co-ordinate measuring machine; applications; laser micrometer, laser interferometer, laser scanning gauge, non contact and in- process inspection, vision system.

Course Outcomes: After successful completion of this course students will be able to:
1. **State** the basic of standards of measurement, limits, fits & tolerances.
2. **Compare** quality in engineering products.
3. **Apply** the principle of measurement in QC & QA aspects and calibration of measuring instruments.
4. **Analysis** the accuracy in the measurement.
5. **Evaluate** the product quality in manner of dimensional accuracy.
6. **Design** limit gauges.

Text & References Books:

1. Jain R.K.; Engineering metrology; Khanna publishers.
3. Gupta. I.C. "A text book of engineering metrology", Dhanpat rai and sons.
4. Galye G.N et al; Metrology for engineers; elbs.
5. Rajput R.K; Engineering metrology and instrumentation; Kataria &sons publishers.

120733: Total Quality Management

(for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective –DE2	Total Quality Management	120733	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2 hrs.

Course objectives: To make the student to understand:

1. The philosophy and core values of Total Quality Management (TQM).
2. How to evaluate best practices for the attainment of total quality.
3. The concept of ISO 9000 and quality manual.
4. The various methods of design and development to improve quality of product.
5. Impact of quality on economic performance and long-term business success of an organization.

Prerequisite: Nil

Syllabus

Unit - I Introduction: Introduction, Need for quality, Evolution of quality, Definitions of quality, Dimensions of product and service quality, Basic concepts of TQM, TQM Framework, Contributions of Deming, Juran and Crosby, Barriers to TQM, Quality statements, Customer focus, Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

Unit - II Principles: Leadership, Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal, Continuous process improvement, PDCA cycle, 5S, Kaizen, Kanban, Supplier partnership, Partnering, Supplier selection, Supplier Rating.

Unit - III Tools and Techniques: The seven traditional tools of quality, new management tools, six sigma: Concepts, Methodology, applications to manufacturing, lean manufacturing, Agile manufacturing, Service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, Types.

Unit- IV Tools and Techniques: Control Charts, Process Capability, Concepts of Six Sigma, Quality Function Development (QFD), Taguchi quality loss function, TPM Concepts, improvement needs, Performance measures.

UNIT- V Quality Systems: Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 – ISO 14000 – Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

Course outcomes: After successful completion of this course students will be able to:

1. **Discuss** about quality measures, Quality control techniques.
2. **Describe** various theories of Total quality management.
3. **Determine** the cost of poor quality and process effectiveness and efficiency to track performance quality.
4. **Apply** appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies.
5. **Evaluate** the performance excellence of an organization, and determine the set of performance indicators
6. **Enhance** management processes, such as benchmarking and business process reengineering

Text & References Books:

1. TQM by Dr, K.C.Arora, S.K.Kataria and sons Publication, Delhi.
2. Jack Hiradsky TQM Hand book McGraw Hill New York
3. JH Taylor TQM Field Manual Mc. Grew Hill Newyork
4. Chrisk Hakes: TQM-The key to business, Chapman and Holland.
5. Kim Todd, "World-class Performance", McGraw Hill, London
6. W J Sivanesan Production/Operations Management. Rich

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Department of Mechanical Engineering

190731: Vehicle Dynamics (for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective-DE2	Vehicle Dynamics	190731	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2hrs.

Prerequisite: Automotive chassis, Automotive transmission, theory of machine.

Course Objectives:

To make the students to understand:

1. Tire and road interaction characteristics.
2. The handling characteristics of vehicle.
3. The longitudinal, lateral and vertical dynamics under braking, acceleration and cornering.
4. How noise and vibrations are generating inside and outside of the vehicle and transfer to the passenger's compartment.

Syllabus

Unit -1 Introduction: Vehicle Dynamics Definitions as prescribed by SAE, Newtonian and: lagrangian formulations of multibody systems. Handling and stability characteristics: Steering geometry, fundamental equations for true rolling, Ackermann steering gear. Steady state handling neutral steer, under steer and over steer, steady state response, yaw velocity, lateral acceleration, curvature response, directional stability.

Unit -2 Performance characteristics of road vehicle: Various forces opposing vehicle motion, their nature and factors affecting these forces. Tractive effort and power available from the engine, equation of motion, maximum tractive effort and weight distribution, stability of vehicle on slop, road performance curves, acceleration, gradability, drawbar pull. Transient operation of vehicles: inertia effects, equivalent mass, equivalent moment of inertia, time taken in synchronization during change of gears, effect of flywheel inertia on acceleration, dynamic of vehicles on banked track, gyroscopic effects , net driving power.

Unit -3 Braking performance: Braking of vehicles, brakes applied to rear wheels, front wheel and all four wheels, motion on straight and curved path, mass transfer effects, braking efficiency, stopping distance, reaction time and stopping time, brake locking anti-lock drives, calculation of mean lining pressure and heat generation during brakes.

Unit- 4 Vehicle ride characteristics: Human response to vibration, vehicle ride models, road surface profile as a random function, frequency response function, evaluation of vehicle vertical vibration to ride comfort criterion.

Unit- 5 Two - wheeler dynamics: Stability & handling, vehicle motion ride control, various vehicle models, gyroscopic effect, effect of tyre and vehicle parameter on stability and handling characteristic.

Course Outcomes:

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

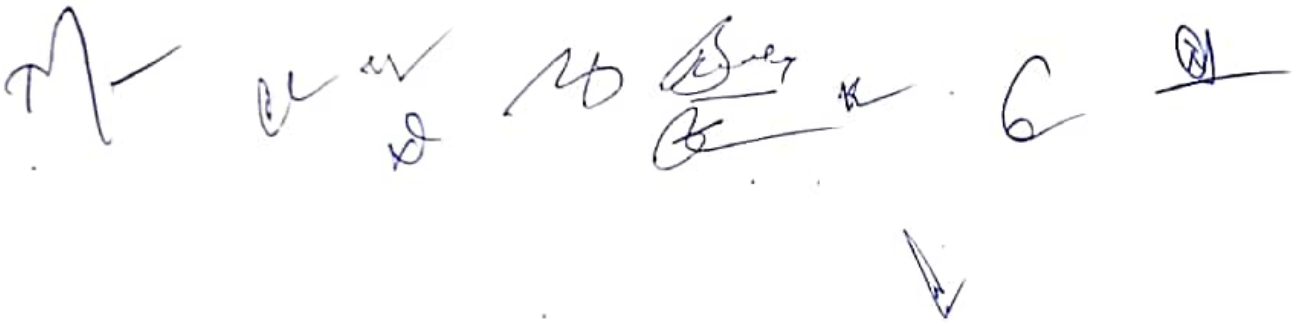
CO1: **Define** the various forces acting on the vehicle.
CO2: **Explain** the tire and road interaction characteristics.
CO3: **Evaluate** the handling characteristics of vehicle.
CO4: **Examine** the vehicle stability under braking, acceleration and cornering.
CO5: **Develop** the mathematical model to predict the ride characteristics of the vehicle.
CO6: **Evaluate** the dynamic performance of two-wheel vehicle.

Text Books:

1. Rao V. Dukkipati, Jian Pang, "Road Vehicle Dynamics problems and solution",SAE,2010
2. Singiresu S. Rao, "Mechanical Vibrations," 5th Edition, Prentice Hall, 2010
3. J. Y. Wong, "Theory of Ground Vehicles", 4th Edition, Wiley-Interscience, 2008
4. Rajesh Rajamani, "Vehicle Dynamics and Control," 2nd edition, Springer, 2012
5. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014

Reference Books:

1. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", 2nd Edition, CRC Press, 2013
2. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", 2nd edition, Springer, 2013
3. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier Limited, 2004
4. Hans B Pacejka, "Tyre and Vehicle Dynamics," 2nd edition, SAE International, 2005
5. John C. Dixon, "Tyres, Suspension, and Handling, " 2nd Edition, Society of Automotive Engineers Inc, 1996
6. Jan Zuijdijk, "Vehicle dynamics and damping," First revised edition, Author House, 2013.



190732- Hybrid Electric Vehicles

(for batch admitted 2020-21)

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective-DE2	Hybrid Electric Vehicles	190732	L	T	P	Max.Marks-60 Min.Marks-19
			3	-	-	Duration-2hrs.

Pre-requisite:

Basic Electrical Engineering, Automotive Electrical & Electronics System

Course Objectives:

To make the students to understand:

1. To provide knowledge about application of hybrid and electric technology.
2. Study of various components of energy storage devices in Vehicles

Syllabus

Unit -I Introduction to Need for Alternative System: History of electric and hybrid vehicles. Need of electric and hybrid vehicles – comparative study of diesel, petrol, electric and hybrid vehicles. Limitations of electric vehicles. Specification of different electric and hybrid vehicles.

Unit -II Energy Storage Devices and Fuel Cells: Electromechanical batteries- types of batteries – lead acid batteries, nickel based batteries, lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency and ultra-capacitors.
Fuel Cell- Fuel cell characteristics- Fuel cell types-Hydrogen fuel cell- Connecting cell in series- water management in the PEM fuel cell- Thermal Management of the PEM fuel cell

Unit-III Electric Vehicles: Electric vehicle layout, performance of electric vehicles – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations, specifications, system components, electronic control system, safety and challenges in electric vehicles.

Unit -IV Hybrid Vehicles: Concepts of hybrid electric drive train, types, architecture of series and parallel hybrid electric drive train, merits and demerits, hybrid electric drive train design, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles.

Unit -V Propulsion Motors and Controllers: Types of electric motors – working principle of AC and DC motors. Characteristic of shunt, series and compound type of DC motors- permanent magnet and separately exited DC motors. AC single phase and 3-phase motor – inverters – DC and AC motor speed controllers.

Course Outcomes:

After successful completion of this course students will be able to:
CO1: **State** the Basic concept of hybrid and electric vehicles.
CO2: **Select** the suitable technology related to different energy storage devices.
CO3: **Demonstrate** hybrid and electric technology.
CO4: **Test** the performance of various energy storage devices and Vehicles.
CO5: **Classify** the various category of Electric motors and controllers used in vehicles.
CO6: **Assemble** the various components of energy storage devices in Vehicles.

Text Books:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003.
2. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003.
3. MehrdadEhsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press,2005.

Reference Books:

1. Ron HodKinson, " light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005.
2. LinoGuzzella, " Vehicle Propulsion System" Springer Publications,2005.

Item ME4	To propose the list of courses which the students can opt from SWAYAM/NPTEL/MOOC based Platforms, to be offered in ***online mode under*** **Departmental Elective (DE)**Courses, with credit transfer in the B. Tech. ***VII Semester under*** the flexible curriculum (***for the batch admitted in 2020-21)***

Departmental Elective (DE) category courses (DE-3 & DE-4)					
Mechanical Engineering			Automobile Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	120761	Foundation of Computational Fluid Dynamics	1	190761	Farm Machinery
2	120762	Introduction to Composites	2	190762	Mechanism and Robot Kinematics
3	120763	Advanced Machining Processes	3	190763	Powder Metallurgy
4	120764	Fundamentals Of Additive Manufacturing Technologies	4	190764	Sustainable Power Generation Systems
5	120765	Energy Conservation And Waste Heat Recovery			
6	120766	Work system Design			

120761: Foundation of Computational Fluid Dynamics

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE 3	Foundation of Computational Fluid Dynamics	120761	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_me75/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	15 sep 2023	24 Sep 2023	8 Weeks

COURSE LAYOUT

Week1
Module1: Introduction
Module 2: Review of basic fluid mechanics
Module 3: Review of equations and importance of terms
Module 4: Review of equations (contd.) and non-dimensionalization
Module 5: Vorticity-Stream function equation, classification of equation and the solution nature
Module 6: Classification of equations (contd.), types of boundary conditions and description about standard test cases.

Week2
Module 1: Steps involved in CFD, Information about Computational domain and grid with illustration
Module 2: Information about grid (contd.); Taylor's series expansion
Module 3: Taylor's series expansion, CD / FD / BD for first & second derivative;
Module 4: FD formula for non-uniform mesh; mixed derivative
Module 5: Derivation for higher derivative; FD formula by Polynomial procedure

Week3
Module 1: Different Approximation Methods
Module 2: Properties associated with discretization
Module 3: Errors due to approximation and their analysis – consistency, convergence
Module 4: Stability analysis
Module 5: FD formulation for model equations and explanation

Week 4
Module 1: FV formulation for diffusion equation – 1D
Module 2: Example and extension to 2D and 3D
Module 3: FV formulation for convection and diffusion equation
Module 4 & 5: Treatment of convective terms - different interpolations

Week 5
Module 1 & 2: Illustration on the performance by different approximation for convection terms
Module 3: Time integration methods
Module 4: Arrangement of variables; Introduction to Pressure velocity coupling, MAC
Module 5: SIMPLE
Module 6: Variants of SIMPLE, Projection Method

Week 6
Module 1: Introduction to Turbulent flows
Module 2: Deriving governing equations
Module 3: Reynolds stresses, modeling strategy
Module 4 & 5: Introduction to Standard models and explanation

Week 7
Module 1: Matrix inversion – Direct, Iterative procedure
Module 2: Direct solver / Iterative solver
Module 3 - 5: Iterative solver

Week 8
Module 1 - 5: Demonstration of a test case with a display of working CFD code and details

Books and references

Anderson, D.C., J.C. Tannehil, and R.H.Fletcher, Computational Fluid Mechanics, Hemisphere Publishing Corporation, NewYork.
Ferziger, J.H. and M.Peric, Computational Methods for Fluid Dynamics, Springer, 3rd Edition, 2002
Versteeg, H.K. and W.Malalasekera, An Introduction to Computational Fluid Dynamics – The Finite Volume method, Second Edition, 2007.
Chung, T.J., Computational Fluid Dynamics, Cambridge University Press, 2002.

120762: Introduction to Composites

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE 3	Introduction to Composites	120762	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course: -
https://onlinecourses.nptel.ac.in/noc23_me89/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 July 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course layout

Week 1: Intro and terminology
Week 2: Concept Review
Week 3: Fibers
Week 4: Matrix materials
Week 5: Short fiber composites
Week 6: Short fiber composites
Week 7: Orthotropic lamina
Week 8: Orthotropic lamina
Week 9: Orthotropic lamina
Week 10: Composite laminates
Week 11: Composite laminates
Week 12: Composite laminates

Books and references

Analysis & Performance of Fiber Composites: Bhagwan D. Agarwal & Lawrence J. Broutman

120763: Advanced Machining Processes

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE3	**Advanced Machining Processes**	**120763**	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_me99/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
21 Aug 2023	13 Oct 2023	28 Oct 2023	8 Weeks

COURSE LAYOUT

Week 1: Introduction to advanced machining processes and their classification
Week 1: Ultrasonic machining and its modelling and analysis
Week 2: Abrasive jet machining (AJM)
Week 2: Water jet cutting (WJC) and Abrasive water jet machining (AWJM)
Week 2: Magnetic abrasive finishing (MAF) and its modelling
Week 3: Abrasive flow finishing (AFF) and its modelling
Week 3: Magnetorheological finishing (MRF)
Week 4: Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis
Week 5: Electric discharge machining (EDM): Principle, applications, process parameters, and modelling
Week 5: Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM)
Week 6: Laser beam machining (LBM)
Week 6: Plasma arc machining (PAM)
Week 6: Electron Beam Machining (EBM)
Week 7: Electro chemical machining (ECM): Principle, applications, and process parameters and modelling
Week 8: Electrochemical Grinding (ECG), Electrostream Drilling (ESD), Shaped Tube Electrolytic Machining (STEM)
Week 8: Chemical machining (ChM)

Books and references

1. V. K. Jain, Advanced Machining Processes, Allied Publishers, 2009
2. Gary F. Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987
3. J. A. McGeough, Advanced Methods of Machining, Springer, 1988
4. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005
5. V. K. Jain, Introduction to Micromachining, Alpha Science International Limited, 2010

120764: Fundamentals Of Additive Manufacturing Technologies

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	Fundamentals Of Additive Manufacturing Technologies	120764	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_me112/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course Layout

Week 1: Introduction to Additive Manufacturing
Week 2: Computer Aided Process Planning for Additive Manufacturing
Week 3: Computer Aided Process Planning for Additive Manufacturing
Week 4: Liquid Additive Manufacturing
Week 5: Liquid Additive Manufacturing
Week 6: Sheet Additive Manufacturing
Week 7: Wire Additive Manufacturing
Week 8: Wire Additive Manufacturing
Week 9: Wire Additive Manufacturing
Week 10: Powder Additive Manufacturing
Week 11: Powder Additive Manufacturing
Week 12: Powder Additive Manufacturing

Books and references

Venuvinod, Patri K., and Weiyin Ma. Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
Kumar, L. Jyothish, Pulak M. Pandey, and David Ian Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
Jacobs, Paul F. "Fundamentals of stereolithography." In 1992 International Solid Freeform Fabrication Symposium. 1992.

120765: Energy Conservation And Waste Heat Recovery

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	Energy Conservation And Waste Heat Recovery	120765	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_me122/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	28 Oct 2023	12 Weeks

Course layout

Week 1: Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
Week 2: Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency
Week 3: Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples
Week 4: Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
Week 5: Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ε-NTU method
Week 6: Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network
Week 7: Heat pipes & Vapor Chambers, Direct conversion technologies –Thermoelectric Generators.
Week 8:Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD
Week 9: Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.
Week10: Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage
Week 11: Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.
Week 12: Energy Economics

Books and references

Nil

120766: Work system Design

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	**Work system Design**		3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_me124/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course layout

Week 1: Work System Design: Introduction, Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models

Week 2: Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity.

Week 3: Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, , Techniques of Work Study, Human Aspects of Work Study

Week 4: Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Examples.

Week 5: Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams.

Week 6: String Diagrams, Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts

Week 7: Memo-Motion Study, Cycle graph and Chrono-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods.

Week 8: Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Steps and Equipment of Time Study,Performance Rating.

Week 9: Performance Rating: Examples, Allowances, Computation of Standard Time-I, Computation of Standard Time-II, Case Study

Week 10: Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST

Week 11: Ergonomics: Basic Concept, Industrial Ergonomics, Ergonomics: Anthropometry, Man-Machine System-1 , Man-Machine System-2

Week 12: Case Study: Office Chair, Case Study: Tower Crane Cabin, Case Study: Car Seat, Case Study: Computer System, Case Study: Assembly Line

Books and references

Introduction to Work Study: International Labor Office (ILO), Geneva.Motion and Time Study

Design and Measurement of Work: Ralph M. Barnes, Wiley, The University of California.

Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.

190761: Farm Machinery

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE3	Farm Machinery	190761	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_ag12/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	28 Oct 2023	12 Weeks

COURSE LAYOUT

Week 1: Importance of farm machines in the contest of enhance production, multiple cropping, labour scarcity etc.
Week 2: Ploughing and first opening of the soil, the design and component details.
Week 3: Machinery of seedbed preparation operation.
Week 4: Equipment for sowing and planting and inter cultivation.
Week 5: Variable Rate Fertilizer Applicator, Microprocessor Based Herbicide Applicator, Spraying etc.
Week 6: Equipment for irrigation
Week 7: Machinery for crop harvesting design and operation
Week 8: Root crop harvesting machinery
Week 9: Machinery for horticultural crops
Week 10: Equipment for crop protection and disease control
Week 11: Machinery for transport and material handling
Week 12: Machinery for land drainage, reclamation and estate maintenance

Books and references

- Principles of Farm machinery Robert Allen Kepner, Roy Bainer, Edgar Lee Barger
- Principles of Agricultural Engineering – Ojha&Michael
- Farm Machinery - Claude Culpin

190762: Introduction to mechanical vibration

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE3	**Introduction to mechanical vibration**	190762	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_ME129/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	15 Sep 2023	24 Sep 2023	8 Weeks

Course layout

Week1: Fundamental of Vibrations.

Week2: Free Vibration of Single Degree of Freedom Systems.

Week3: Forced Vibration of Single Degree of Freedom Systems.

Week4: Forced Vibration of Single Degree of Freedom Systems.

Week5: Vibration Measuring Instruments.

Week6: Vibration of Two Degree of Freedom Systems.

Week7: Vibration Absorbers and Critical Speed of Shafts.

Week8: Vibration of Multi Degree of Freedom Systems.

Books and references

- Grover, G.K., " Mechanical Vibrations", 7th Ed., Nem Chand & Bros.
- Rao, S.S., " Mechanical Vibrations", 5th Ed., Addison-Wesley Longman, Incorporated.
- Thomason, W.T., "Theory of Vibrations with Applications", 5th Ed., Prentice-Hall.
- Timoshenko, S.P., "Vibration Problems in Engineering", 2nd Reprint Ed., Wolfenden Press.
- Kelly, S.G., "Mechanical Vibrations", Segaum's Outlines, Mc Graw Hill Education

190763: Powder Metallurgy

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	Powder Metallurgy	190763	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_mm35/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	28 Oct 2023	12 Weeks

Course layout

Week 1: Introduction to Powder Metallurgy, Definition of Powder, Why Powder Metallurgy
Week 2: Powder Fabrication: Mechanical & Chemical fabrication
Week 3: Powder Fabrication: Electrolytic fabrication & Atomization
Week 4: Microstructure control, Powder Characterization
Week 5: Powder Characterization: Particle size measurement, BET surface area, Interparticle friction
Week 6: Powder packing, mixing and blending
Week 7: Shaping and Compaction
Week 8:Slurry techniques, Cold Isostatic Pressing (CIP)
Week 9:Sintering: Sintering theory, Solid state sintering
Week 10: Activated and Liquid phase Sintering
Week 11: Full density processing
Week 12: Hot Isostatic Pressing (HIP), Spark Plasma Sintering (SPS)

Books and references

1. Powder Metallurgy Science, Rendall M. German, 2nd Ed. Metal Powder Industries Federation, 1994

190764: Sustainable Power Generation Systems

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Departmental Elective-DE4	Sustainable Power Generation Systems	190764	3	-	-	As per SWAYAM/NPTEL norms

SWAYAM/NPTEL Link for the course:
https://onlinecourses.nptel.ac.in/noc23_ge47/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24 Jul 2023	13 Oct 2023	29 Oct 2023	12 Weeks

Course layout

Week 1: Module-1: Introduction to power generation
Global and Indian scenario, an overview of current technologies available for power generation, Concept of the renewable energy- based power plant

Week 2: Module-2: Solar Thermal Power Generation
Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator), ORC, RC, and Stirling engine.

Week 3: Module-3: Solar Photovoltaic Power Generation
Fundamentals of Solar photovoltaic energy conversion, Solar PV power plant design, Performance analysis of standalone and grid connected PV systems.

Week 4: Module-4: Wind Power Generation
Introduction to wind turbine, classification and analysis of different components, Theory, design and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.

Week 5: Module-5: Hydro Power Generation
Introduction to hydro power plant, overview of micro, mini and small hydro power plants, hydraulic turbines, Selection and design criteria of pumps and turbines, Brief theory, design and analysis of hydro power plants

Week 6: Module-6: Biomass Power Generation
Fundamentals of bioenergy production technologies through different routes, design and analysis of biochemical and thermochemical reactors for clean power generation and value- added products, IGCC.

Week 7: Module-7: Hydrogen energy and fuel cells
Importance, various routes of hydrogen generation, basic principle and design of different types of fuel cells and thier applications, future prospects, IGFC

Week 8: Module-8: Geothermal Energy
Fundamentals, classification, theory, design and analysis of geothermal power plant

Week 9: Module-9: Ocean Thermal Energy
Fundamentals, classification, theory, design and analysis of ocean thermal power plant

Week 10: Module-10: Wave and Tidal Energy
Fundamentals, classification, theory, design, and analysis of wave and tidal power plant

Week 11: Module-11: Energy Storage
Different modes of energy storage; design and analysis of different technologies for thermal, mechanical, and electro-chemical energy storage systems

Week 12: Module-12: Energy Economics
Cost analysis, interest, Accounting rate of return, Payback, Discounted cash flow, Net present value, Internal rate of return, Inflation and life cycle analysis of energy systems.

Books and references

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, springer, 2nd Edition, 2019.
8. S.p Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Private Limited, 3rd Edition, 2010.

Item ME5	To prepare and finalize the syllabus of courses to be offered ***(for the batch admitted in 2020-21)*** under the ***Open Category (OC) Courses***(in traditional mode) for B. Tech. ***VII semester*** students of other departments along with their COs

Open Category (OC2)		
S.No.	**Subject Code**	**Subject Name**
1	910208	Solar Energy
2	910209	Maintenance Engineering
3	910210	Supply Chain Management

For batch admitted in Academic Session 2020-21

910208: SOLAR ENERGY

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Solar Energy	910208	2	1	-	Max. Marks – 60 Min. Marks – 19 Duration – 2 hrs

Course Objective: To make the students to understand:

1. The basic concepts of solar energy and various sun-earth angles.
2. How to develop thermal models and how to carry out economic analysis of solar systems and establish energy balance in different solar energy systems.
3. The different types of collectors, PV systems and their application.

Course Prerequisites: Basic Physics

Syllabus

UNIT – I Solar radiation, basic concepts, various Sun – Earth angles and modeling

UNIT – II Solar collectors and types: flat plate, concentrating solar collectors, Selective coatings, thermal modeling of flat plate collectors, applications of solar collectors.

UNIT – III Active and passive heating and cooling of buildings, Home lighting systems.

UNIT - IV Solar energy storage options, Solar Economics and life cycle cost analysis.

UNIT –V Solar photo voltaic System: Basic concepts of solar cell and PV Panel in series and parallel combination, characteristics curves of PV cell and panels, Photovoltaic materials, Need for different cell design, Applications of photovoltaic for power generation.

Course Outcomes: After successful completion of this course students will be able to:

1. **Define** the basic terms used in solar systems and various sun-earth angles.
2. **Establish** the energy balance and develop the thermal model of different solar systems.
3. **Investigate** the effectiveness of utilizing the solar energy by different solar systems.
4. **Analyze** the life cycle cost and other economic aspects of solar systems
5. **Describe** the application of solar systems and find out the areas of improvement.

Recommended Books:

1. Solar Energy by G.N. Tiwari
2. Solar Energy: Problems, Solution and Experiments by G.N. Tiwari, P. Barnwal, S.C. Solanki and M.K. Gaur
3. Solar Energy by John A. Duffie, William A. Beckman
4. Solar Energy by S.P. Sukhatme and J.K. Nayak

For batch admitted in Academic Session 2020-21

910209: Maintenance Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	Max.Marks-60
Open Course-OC2	Maintenance Engineering	910209	2	1	-	Min.Marks-19 Duration-2 hrs.

Course Outcomes: Through this course, student should be able to

- Identify different maintenance categories
- Understand the principles, functions and practices adopted in industry for the successful management of maintenance activities
- Implement the maintenance function and different practices in industries for the successful management of maintenance activities.
- The Condition Monitoring & Non-Destructive Testing.
- The fault Identification, Computerized Maintenance Systems.
- The Maintenance strategies and overall configuration and Maintenance of Machines, structure and System.

UNIT I

Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept, importance of maintenance, elements of good maintenance classification of maintenance programs, corrective preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance-concept, functions, benefits and limitations, training and safety aspects in maintenance.

UNIT II

Condition monitoring, objectives and benefits of condition based monitoring, what to monitor, when to monitor, principles, condition based maintenance techniques: visual/manual monitoring, temperature monitoring, thermography, lubricant monitoring, debris and spectroscopy, performance monitoring, vibration monitoring, current monitoring, and corrosion monitoring, odour monitoring, noise and sound monitoring, Time Domain Analysis, Frequency Domain Analysis, Non Stationary Signal Analysis, Practical Examples of Vibration.

UNIT III

Tribology in Maintenance, Friction wear and lubrication, friction & wear mechanisms, prevention of wear, types of lubrication mechanisms, lubrication processes, lubricants and its types, general and special purpose, additives, testing of lubricants, degradation of lubricants, seal & packings, repair methods for basic machine elements: failure analysis, failures and their development.

Unit- IV:

Accelerometers, Rotational Speed Measurements, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Gears, Pumps and Cavitation, IC Engines, machinery Diagnostic Chart, Basics of Instrumentation, Signal Conditioning and Filtering, Errors In Measurements, Dynamic Range And Frequency Response.

Unit- V: Non-Destructive Testing, Ultrasonics, Eddy Current and Acoustic Emission, Radiography, Dye Penetrant Tests, Tool Condition Monitoring, Experimental Modal Analysis, Introduction to Failure Analysis, Railway Locomotive Noise and Vibration Monitoring, Paper Mill Vibration Monitoring, Overview of CBM facilities at SKF Reliability Lab, Artificial Intelligence in Maintenance Engineering, Expert Systems for fault Diagnosis, IoT in Maintenance Engineering.

Course Outcomes: After successful completion of this course students will be able to:

1. **Describe** the fundamental concepts of maintenance engineering noise and vibration, measurement techniques of Condition Monitoring.
2. **Show** skills of fault diagnosis.
3. **Demonstrate** the need of instrumentation and signal processing for condition monitoring
4. **Examine** the condition of machine parts through Failure analysis of plant machineries
5. **Apply** correct usage of a method or procedure of maintenance.

Text & Reference books:

- A. R. Mohanty, Machinery Condition Monitoring: Principles and Practices, CRC Press, 2014
- Bikash Bhadury. 'Total Productive Maintenance". Allied Publisher Ltd. New Delhi.
- BC langlay. "Plant Maintenance". Prentice-Hall International. New Jersey.
- P Gopalakrishnan and AK Banerji, "Maintenance and Spare Parts Management". Prentice-Hall of India (P) Ltd. New Delhi.
- Kelly, "Maintenance Planning & Control"
- Industrial Maintenance by HP Garg. S. Chand & Company Ltd., New Delhi.
- Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
- Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995
- White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
- Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
- Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
- Armstrong, "Condition Monitoring", BSIRSA, 1988.
- Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996.

910210: Supply Chain Management

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Course-OC2	Supply Chain Management	910210	2	1	-	Max. Marks – 60 Min. Marks – 19 Duration – 2hrs

Course Objective: To make the students to understand:

1. The basic concepts of Supply Chain Management.
2. Goal of a supply chain and find out the impact of supply chain on the success of the firm.
3. The network Design and Synthesize different real-life cases.

Course Prerequisites: NIL

Syllabus

Unit 1: Introduction to Supply Chain Management: Overview of Supply Chain Management, Evolution and Importance of Supply Chain Management, Decision Phases in Supply Chain, Process Views of a Supply Chain, Competitive and Supply Chain Strategies, Strategic Fit, Supply Chain Drivers and Metrics, The role IT in supply chain.

Unit 2: Supply Chain Network Design: Role of Distribution in Supply Chain, Factors influencing Distribution network design, Design options for Distribution Network, Online Sales and the Distribution Network, Distribution Network in Practice, Role of network Design in Supply Chain, Framework for network Decisions, The Impact of Globalization on Supply Chain Networks.

Unit 3: Demand Planning and Forecasting: The Role of Forecasting in a Supply Chain, Characteristics of Forecasts, Classification, Forecasting Techniques and Models: Forecasting Methods, Time-Series Forecasting Methods; Aggregate Planning in Supply Chain, Sales and Operations Planning, Supply Chain Coordination and the Bullwhip Effect.

Unit 4: Inventory Management: Introduction to Inventory Management, Types of Inventory and Inventory Costs, Economic Order Quantity (EOQ) and Reorder Point, Inventory Control Models: ABC Analysis, JIT, and Safety Stock, Vendor-Managed Inventory (VMI) and Collaborative Planning.
Sourcing and Procurement: Role of sourcing in supply chain, Outsourcing benefit, Importance of suppliers, evaluating a potential supplier, Supplier selection, Supply contracts, Competitive bidding and Negotiation, Procurement Process, E-procurement.

Unit 5: Logistics and Transportation Management: Introduction to Logistics Management, Role of transportation in supply chain, factors affecting transportations decision, Design option for transportation network, Transportation Modes: Selection and Trade-offs, Freight Management and Distribution Network Design, Warehouse Operations and Materials Handling, Reverse Logistics and Sustainable Supply Chains. Lean Supply Chain and Six Sigma, Emerging Trends in Supply Chain Management.

Course Outcomes: After successful completion of this course students will be able to:

1. **Develop** the various supply chain and network design.

2. **Apply** the forecasting methods in supply chain.
3. **Investigate** the effectiveness of utilizing the supply chain.
4. **Analyse** the inventory level and other economic aspects of supply chain.
5. **Describe** the application of supply chain and find out the areas of improvement.

Recommended Books:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education
2. Mohanty. R. P, Deshmukh. S. G., Supply chain Management, Phoenix publishing
3. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI,
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press
5. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition.

Item ME6	To prepare and finalize the Experiment list/ Lab manual for Departmental Laboratory Course (DLC) to be offered in B. Tech. VII semester ***(for the batch admitted in 2020-21)***

S.No.	Subject Code	Subject Name
1	120715	Reliability and Vibration Lab
2	190715	Automotive Maintenance

120715- (DLC-): Reliability and Vibration Lab

Category	Title	Code	Credit - 1			Practical Paper
			L	T	P	Max.Marks-60
Departmental Lab Core- DLC	Reliability and Vibration Lab	120715	-	-	2	Min.Marks-19

Course Objectives:

1. To understand the fundamentals of Vibration Theory.
2. To be able to mathematically model real-world mechanical vibration problems.
3. To be able to resolve industrial problems related to vibration and noise.

List of Experiments

1. Determination of Critical Speed in Whirling of Shafts.
2. Determination of Natural Frequency in Longitudinal Vibrating System.
3. Determination of Natural Frequency in Torsional Vibration System.
4. To verify the relation of compound pendulum & to determine the radius of gyration
5. To study the undamped free vibration of spring mass system.
6. To study the forced vibration of simply supported beam for different damping.
7. Undamped tensional vibrations of single and double rotor system.
8. To study the damped torsional vibration of single rotor system and to determine the damping coefficient.
9. To study the forced damped vibration of spring mass system.
10. Study the machine fault diagnostic system based on vibration analysis.

Text Books:

1. **Mechanical Vibrations**: by G K Groover.

References Books:

1. **Theory of Vibrations with Applications**: W T Thomson CBS Publishers Delhi
2. **Mechanical Vibrations**: S SRao Addison-Wesley Publishing Co.
3. **Fundamentals of Vibration:** Leonard Meirovitch , McGraw Hill International Edison.

190715: Automotive maintenance lab

Category	Title	Code	Credit-1			Lab End term
			L	T	P	
Departmental Laboratory Course - DLC	**Automotive maintenance lab**	**190715**	-	-	2	Max. Marks: 60 Min Marks: 19

Prerequisite: Basic knowledge IC Engine, Two Strokes, Four stroke Engine

List of Experiments-

1. Study and layout of an automobile repair, service and maintenance shop.
2. Study and preparation of different statements/records required for the repair and maintenance works.
3. Cylinder reboring – checking the cylinder bore, Setting the tool and reboring.
4. Valve grinding, valve lapping - Setting the valve angle, grinding and lapping and checking for valve leakage
5. Calibration of fuel injection pump
6. Minor and major tune up of gasoline and diesel engines.
7. Study and checking of wheel alignment - testing of camber, caster.
8. Brake adjustment and Brake bleeding.
9. Battery testing and maintenance

Course Outcomes: After Successful completion of this course lab students will be able to:

CO1. Explain the process involved in repairing/servicing of a vehicle.
CO2. Analyze the different the different tool for operating the maintenance of a vehicle.
CO3. Describe the requirement of wheel alignment.
CO4. Discuss the phenomena ad working of braking system
CO5. Classify different body parts or accessories of a vehicle.
CO6. Illustrate different types and function of battery

Item ME7	To propose the list of "Additional Courses" which can be opted for getting an ***(i) Honours (for students of the host department)*** ***(ii) Minor Specialization (for students of other departments)*** *[These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the* B.Tech. ***VII semester students*** *(for the batch admitted in 2020-21)] and for* B.Tech. ***V semester*** *(for the batch admitted in 2021-22)]*

Honors list (For Mechanical/Automobile Engg. Students)

Sr No	Design Track		Thermal Track		Production Track	
	Honors (Jan.-June)	Honors (July-Dec.)	Honors (Jan.-June)	Honors (July-Dec.)	Honors (Jan.-June)	Honors (July-Dec.)
1	Design, Technology and Innovation(8 week)	Mechanical Behavior of Materials (12 week)	Computational Fluid Dynamics for Incompressible Flows(12 Weeks)	Power Plant Engineering (8week)	Introduction To Mechanical Micro Machining(8 weeks)	Fundamentals of manufacturing processes (12 week)
2	Experimental Stress Analysis(12 weeks)	Fracture, Fatigue and Failure of Materials (12 week)	Turbulent Combustion: Theory And Modelling(12 weeks)	Advanced Thermodynamics and Combustion (12 week)	Product Design and Manufacturing(12 weeks)	Rapid Manufacturing (12 week)
3	Robotics: Basics and Selected Advanced Concepts(8 weeks)	Introduction To Composites (12 week)	Experimental Methods in Fluid Mechanics(12 Weeks)	Advanced Fluid Mechanics (12 week)	Mechanics of Fiber Reinforced Polymer Composite Structures(12 weeks)	Fundamentals of Additive Manufacturing Technologies (12 week)
4	Modeling and Simulation of Dynamic Systems(8 Weeks)	Solid Mechanics (12 week)	Heat Transfer and Combustion in Multiphase Systems(8 Weeks)	Heat Exchangers: Fundamentals And Design & Analysis (12 week)	Fundamentals Of Electronic Materials And Devices (8 weeks)	Automation in Manufacturing (12 week)

Minors list (other than Mechanical/Automobile Engg. students)

Sem	V (for the batch admitted in 2021-22)	VI (for the batch admitted in 2020-21)	VII (for the batch Admitted in 2020-21)
Course Name	1. Basics of Materials Engineering (12 Weeks) 2. Fluid Mechanics (12 Weeks)	1. Fundamental of Combustion (12weeks) 2. Introduction to Mechanical Micro Machining (12 weeks)	1. Engineering Metrology (12 Weeks) 2. Applied Thermodynamics for Engineers (12 Weeks)

Item ME8	To prepare and recommend the ***scheme structure of B.Tech. V Semester under*** the flexible curriculum (for the *Batch admitted in 2021-22)*

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
Scheme of Evaluation

For batch admitted in Academic Session 2021-2022

B.Tech. V Semester (Mechanical Engineering)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	"Mode of Exam.	Duration of Exam
				Theory Slot				Practical Slot				L	T	P				
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation									
				End Sem. Exam	'Proficiency in subject /course	Mid Sem. Exam	Quiz/ Assignment		Lab work & Sessional	Skill Based Mini Project								
1	120519	MC	Data Science	50	10	20	20	60	20	20	200	3	-	2	4	Blended	MCQ	1.5 hr
2	120520	DC	Theory of Machines –II (DC-9)	50	10	20	20	60	20	20	200	2	-	2	3	Blended	AO	2 hr
2	120511	DC	Industrial Engineering (DC-10)	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2 hr
3	120513	DC	Heat and Mass Transfer (DC-11)	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
5	120515	DC	Machine Design (DC-12)	50	10	20	20	60	20	20	200	2	1	2	4	Blended	AO	2 hr
6	120516	DLC	Minor Project-I**	-	-	-	-	60	40	-	100	-	-	4	2	Offline	SO	
7	120517	Seminar/ Self-Study	Self-learning Presentation (SWAYAM/NPTEL MOOC)*	-	-	-	-	-	40	-	40	-	-	2	1	Offline	SO	
8	200XXX	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Offline	SO	
9	120518	DLC	Summer Internship Project-II (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO	
Total				250	50	100	100	410	160	80	1150	11	3	20	24	-	-	
10	1000006	MAC	Disaster Management	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ	1.5 hr
Additional Course for Honours or minor Specialization				Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization														

'Proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.
"MCQ: Multiple Choice Question "AO: Assignment + Oral "PP: Pen Paper "SO: Submission + Oral
** The Minor Project-I may be evaluated by an internal committee for awarding sessional marks.
* Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	NEC	Theory			Lab	NEC	
Offline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
0	0	18	-	5	1	7	7	4	5	1	24
0	0	75	-	20.8	4.1	29.16	29.16	16.66	20.8	4.1	100

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Department of Mechanical Engineering

Scheme of Evaluation

For batch admitted in Academic Session 2021-2022

B.Tech. V Semester (Automobile Engineering)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	^{55}Mode of Exam.	Duration of Exam
				Theory Slot				Practical Slot				L	T	P				
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation									
				End Sem. Exam.	^{5}Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab work & Sessional	Skill Based Mini Project								
1.	190519	MC	Data Science	50	10	20	20	60	20	20	200	3	-	2	4	Blended	MCQ	1.5 hr
2.	190511	DC	Industrial Engineering (DC-9)	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2 hr
3.	190513	DC	Heat and Mass Transfer (DC-10)	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
4.	190514	DC	Design of Machine Elements (DC-11)	50	10	20	20	60	20	20	200	2	1	2	4	Blended	AO	2 hr
5	190520	DC	Automotive Chassis (DC-12)	50	10	20	20	60	20	20	200	2	-	2	3	Blended	PP	2 hr
6.	190516	DLC	Minor Project-I	-	-	-	-	60	40	-	100	-	-	4	2	Offline	SO	
7.	190517	Seminar/ Self-Study	Self-learning Presentation (SWAYAM/NPTEL/ MOOC)*	-	-	-	-	-	40	-	40	-	-	2	1	Offline	SO	
8.	200xxx	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Offline	SO	
9.	190518	DLC	Summer Internship Project-II (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO	
Total				250	50	100	100	410	160	80	1150	11	3	20	24			
10.	1000006	MAC	Disaster Management	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ	1.5 hr
Additional Course for Honours or minor Specialization				Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization														

^{5}proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

^{55}MCQ: Multiple Choice Question ^{55}AO: Assignment + Oral ^{55}PP: Pen Paper ^{55}SO: Submission + Oral

$^{\#}$The Minor Project-I may be evaluated by an internal committee for awarding sessional marks.

*Compulsory registration for one online course using SWAYAM/NPTEL/MOOC, evaluation through attendance, assignments and presentation

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	NEC	Theory			Lab	NEC	
Offline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
0	0	18	-	5	1	7	7	4	5	1	24
0	0	75	-	20.8	4.1	29.16	29.16	16.66	20.8	4.1	100

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Item ME9	To prepare and recommend the syllabi for all ***Departmental Core (DC) Courses*** of B. Tech. ***V Semester (for batch*** **admitted in 2021-22)** under the flexible curriculum along with their COs.

Automobile Engineering			Mechanical Engineering		
S.No.	Subject Code	Subject Name	S.No.	Subject Code	Subject Name
1	190511	Industrial Engineering	1	120511	Industrial Engineering
2	190513	Heat and Mass Transfer	2	120513	Heat and Mass Transfer
3	190514	Design of Machine Elements	3	120515	Machine Design
4	190520	Automotive Chassis	4	120520	Theory of Machines-II

190511/120511: Industrial Engineering

Category	Title	Code	Credits: 3			Theory Paper
			L	T	P	
Departmental Core-DC	Industrial Engineering	190511/120511	2	1	-	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Course Objectives: Industrial engineering is concerned with the design, improvement, installation, and management of integrated systems of men, material, and machine. After completing this course, students will learn a set of skills that includes mathematical modeling, probability and statistics, computer science, human factors, interpersonal skills, project management, and an ability to manage and administer large technical engineering and research projects. Thus, industrial engineering may be thought of as applied problem-solving, from inception to implementation.

Syllabus

UNIT-I

Production Systems and Productivity: Design of production systems (product, job shop and batch), Types of Production System, Definition and types of productivity, Measurement of productivity, factors affecting the productivity and productivity improvement programs.

Production Planning and Control: Needs of Production Planning and control, objectives of PPC, Principles of PPC, Functioning of PPC, Factor determining the PPC and Elements of PPC.

UNIT-II

Demand Forecasting: Introduction, demand patterns, Need and classification of forecasting techniques, factors affecting forecasting, time series analysis, qualitative methods- measures of forecast accuracy and error analysis in quantitative forecasting.

Aggregate Planning: Introduction to Aggregate Planning, Factors affecting aggregate planning, objectives and aggregate planning strategies, aggregate planning methods.

UNIT-III

Inventory Control: Meaning and types of inventories, objectives, and functions, need and classifications-codification and standardization, inventory control terminology, inventory cost relationship, deterministic and probabilistic inventory models, quantity discount, Probabilistic inventory management, economic ordering quantity procurement cost, carrying charges, lead-time, reorder point, selective control of inventory

UNIT-IV

Master Production Scheduling and MRP: Functions, planning horizon and planning periods for master production schedule, types of master production schedule, Bill of Material, Independent Demand versus dependent demand, Functions of material requirements planning and manufacturing resource planning (MRP I and MRP II), inputs for MRP system, performance characteristics of MRP system, materials requirement planning explosion.

Unit-V

Production Scheduling and control: Production control outline, Gantt chart, n jobs and 2 machine problems, n jobs and 3 machine problems, Johnson's algorithm, scheduling strategies, concept of single machine scheduling.

shortest Processing time rule, earliest due date, Model to Minimize total tardiness, branch, and bound technique to minimize tardiness. Floor shop scheduling, Job shop scheduling

Facility Locations, Plant Layout and Material Handling: Facility location factors and evaluation of alternate locations; qualitative aspects, quantitative models for layout decisions, types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing, materials handling systems.

Course outcomes: After learning the course the students should be able to:

- **CO1.** **Define** and measure productivity.
- **CO2.** **Understand** Production planning and control required for industry to analyze the engineering problems.
- **CO3.** **Apply** engineering design to produce solutions that meet specified needs of manufacturing industry
- **CO4.** **Analyze** practice through various Management and Operation Tools for Improving Quality and Quantity.
- **CO5.** **Evaluate** various kinds of problems or issues faced by service and manufacturing industries like Inventory control, sales forcasting economic consideration, optimum utilization of resources, productivity.
- **CO6.** **Create** new mathematical models for efficient production planning and control.

Text Books:

1. Industrial Engineering and Production Management, Martand Telsang, S. Chand
2. Production and Operation Management by R. Panneerselvam, PHI, Latest Edition
3. Manufacturing planning and control for SCM by Vollmann; TMH, Latest Edition.
4. Purchasing & Materials Management by Dobler & Lee, PHI, Latest Edition

Reference Books:

1. Operations Management by Krajewski, L. J., Ritzman, L. P. and Malhotra, M. K., Prentice Hall, New Delhi; Latest Edition.
2. Production/Operations Management by Ebert, J and Adams, D.J., Prentice Hall of India, New Delhi; Latest Edition.
3. Production and Operations Management: manufacturing and services by Chase, R. B., Aquilano, N. J. and Jacob, F. R., TMH, New Delhi; Latest Edition .
4. Modern Production/Operations Management by Buffa and Sarin, Wiley India; Latest Edition.

List of Open Source Software/learning website:

1. Operation Management, IIT Roorkee, Dr. Inderdeep singh, https://nptel.ac.in/courses/112107238
2. Operation and Supply chain Management, IIT Madras, Prof. G. Srinivasan https://nptel.ac.in/courses/110106045

190513/120513: Heat and Mass Transfer

Category	Title	Code	Credits -4			Theory Paper
			L	T	P	
Departmental Core-DC	Heat and Mass Transfer	190513/120513/ 120503/190503	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Objectives: To make the students understand:

1. the comprehensive of physical science and its fundamentals applicable to the engineering discipline of heat and mass transfer.
2. the fundamentals of heat transfer mechanisms in fluids and solids.

Syllabus

UNIT I - Fundamental of Heat Transfer: Modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's law, thermal conductivity and its variation with temperature, film coefficient of heat transfer, general heat conduction equations, Steady state heat transfer: Thermal resistances and conductance, overall Heat transfer Coefficient, Heat transfer through plane and composite wall, hollow and composite hollow cylinder and sphere, thermal diffusivity, one dimensional steady state conduction with heat generation , critical thickness of insulation. Unsteady State Heat Transfer: Transient and periodic conduction, Lumped System Analysis, heating and cooling of bodies with known temperature distribution, response of thermocouple.

UNIT II - Convection Heat Transfer: Introduction to Free and Forced Convection, laminar and turbulent flow, forced convection through hydrodynamic and thermal boundary layers, analysis of hydrodynamic and thermal boundary layer. Empirical equations of convection heat transfer. Heat Transfer in a circular pipe (forced convection). Applications of dimensional analysis to free and forced convection. Reynolds Number, Prandtl Number, Grashoff Number, Nusselt numbers, and Boit Number

UNIT III - Heat Exchangers: Basic types of heat exchanger. Logarithmic Mean Temperature Difference (LMTD), fouling factor, heat exchanger effectiveness, NTU Methods. Extended surfaces: Pin-Fin and rectangular fin of uniform cross section. Effectiveness and efficiency of Fin. Use of fin analysis for measuring, thermometric error, triangular and parabolic profile.

UNIT IV – Thermal radiation: Basic concept. Monochromatic and total emissive power, absorptivity, reflectivity and transmissivity, Kirchhoff's law, Concept of Black & Grey bodies. Plank's distribution law.Wien's displacement law. Steffen – Boltzmann law, Concept of Shape factor. Condensation heat transfer: Introduction, process, Theory of laminar film condensation. Nusselt's Theory. Drop wise condensation. Influence of the presence of non-condensable gases. Boiling heat transfer: Nature, Boiling regimes, Bubble size consideration, bubble growth and Collapse. Critical diameter, Rosen how Correlation.

Unit V - Diffusion Mass Transfer: Fick's law. Steady state diffusion of gases and liquids through solids, Equi-molal diffusion, isothermal diffusion, isothermal evaporation of water into air. Mass transfer coefficient. Convective Mass Transfer: Mass transfer through boundary layer. Analogy between momentum heat & mass transfer. Dimensional analysis, application to convective mass transfer. Forced convection mass transfer in laminar and turbulent flow through tubes. Simultaneous heat and mass transfer.

Course Outcomes: After successful completion of this course students will be able to:

CO1. Formulate and solve one-dimensional conduction with and without heat generation
CO2. Apply the empirical equations to analyze various convection problems
CO3. Evaluate the performance of various types of heat exchangers
CO4. Develop the mathematical and physical concept of radiation heat transfer
CO5. Apply the physics of heat transfer in the processes like Condensation and Boiling
CO6. Analyze and solve the problems in diffusion and convective mass transfer

Text Books:

1. Kumar D. S, Heat & Mass Transfer, Latest Edition, Katson Publication.
2. Rajput R. K., Heat & Mass Transfer, Latest Edition, S. Chand Publication.

References Books:

1. Arora & Domkundwar, A course in Heat & Mass Transfer, Latest edition, Dhanpat Rai& Co. Publication.
2. Nag P K, Heat Transfer, Latest Edition, McGraw-Hill
3. Holman J. P., Heat Transfer, Latest Edition, TMH.
4. Kreith & Bohn, Principles of Heat Transfer, Latest Edition, CL Engineering Publication.
5. Cengel Yunus A., Heat and Mass Transfer, Latest Edition, TMH.
6. Thirumaleshwer M., Heat and Mass Transfer by, Latest Edition, Pearson

List of Experiments:

1. Determination of Thermal Conductivity of Metal Rod.
2. Determination of Thermal Conductivity of Insulating Powder.
3. Measurement of Emissivity.
4. Determination of Stefan-Boltzmann constant.
5. Determination of Heat Transfer coefficient by Pin-Fin Apparatus.
6. Determination of Effectiveness of Shell and Tube heat exchanger.
7. Determination of Effectiveness of Parallel and Counter Flow Heat Exchanger.
8. Determination of Heat transfer coefficient by Forced Convection.
9. Determination of Heat Transfer coefficient during drop and film wise condensation.
10. To study the drying characteristics of different wet granular materials using natural and forced circulation in a tray dryer.
11. To determine the diffusion coefficient of liquid vapor in air by Stefan's tube.

Lab Course Outcomes: After successful completion of this course students will be able to:

CO1: Determine the thermal conductivity of metal rod and insulating powder.
CO2: Estimate the Stefan-Boltzmann constant and measurement of emissivity.
CO3: Determine the effectiveness of various types of heat exchangers.
CO4: Evaluate the Heat Transfer coefficient in various heat transfer phenomena.
CO5: Evaluate the diffusion coefficient of liquid vapor in air by Stefan's tube.

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Department of Mechanical Engineering

For batches admitted in Academic Session 2021-22

190514: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Design of Machine Elements	190514/ 190504	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:

Engineering Mathematics-I
Mechanics of Materials

Course Objectives:

To make the students to understand:
1. develop an ability to apply knowledge of mathematics, science and engineering.
2. develop an ability to design a system, component or process to meet desired needs within realistic constraints.
3. develop an ability to identify, formulate, and solve engineering problems.
4. develop an ability to use techniques, skills and modern engineering tools.

Syllabus:

Unit I - Design Philosophy: Principles of mechanical design; Factor of safety, Limits and fits; Standardization; Selection of materials, Theory of failures.

Unit II- Design of Keys, Shafts and Couplings: Definitions, classifications and applications design of rigid and pin bushed flexible couplings.

Unit III- Design of Permanent and Temporary Joints: Cotter and knuckle joints; screwed fastenings, bolted and riveted joints under direct and eccentric loads. Welded joints: Welded joints, strength of welded joints, eccentrically loaded welded joints, welded joints subjected to bending moments and torsion.

Unit IV- Design of Mechanical Gears: Design of spur, helical, bevel and worm gears.

Unit V- Design of Bearings: Rolling contact bearing: Types of rolling contact bearing, static and dynamic load capacities, Stribeck's equation, equivalent bearing load, load life relationship, bearing life, bearing life, load factor, selection of bearing from manufacturing catalogue. Sliding contact bearing: Bearing material and their properties, bearing types and their constructional details. Design consideration in hydrodynamic bearings.

Course Outcomes:

After successful completion of this course students will able to:

CO1: Illustrate the design Philosophy and Principles of mechanical design.
CO2: Identify appropriate bearing for a given application.
CO3: Use design data books in designing various mechanical components.

CO4: Select appropriate drive for power transmission on the basis of load and speed.
CO5: Analyze the stresses and strain induced in basic mechanical components.
CO6: Design the machine elements against static as well as fatigue load.

Text Books:

1. V.B. Bhandari, "Design of Machine Elements, Tata McGraw- Hill Education.
2. R.K. Jain, "Machine Design", Khanna Publishers, New Delhi, 1997.
3. R C Juvinall Fundamental of Machine Components Design, 4/e, Wiley.
4. P C Gope, Machine Design: Fundamental and Applications, 1/e PHI.
5. R L NORTON, Machine Design an Introduction, Pearson.
6. E J Hearn, Mechanics of Material, BH.

References Books:

1. P.M. Heldt "High speed combustion Engine", Oxford-IBH Publishing Co., Calcutta, 1965.
2. A.Kolchin and V.Demidov, "Design of automotive engine", MIR Publisher, Moscow, 1984.
3. Sundararaja Murthy, T.V. "Machine Design", Khanaa publisher, New delhi.
4. "Design Data book", PSG College of technology, Coimbatore,2000.

NPTEL Link for Design of Machine Elements

http://nptel.ac.in/courses/112105124/

List of Experiments

1. Design and drawing of Single, double and triple riveted joint
2. Design and drawing of Single and double strap butt joint
3. Design and drawing of Welded joint
4. Design and drawing of Socket and Spigot cotter joint
5. Design and drawing of Gib and Cotter joint.
6. Design and drawing of Knuckle joint
7. Study of Theories of failure
8. Design and drawing of Solid and hollow shaft
9. Design and drawing of Rigid coupling
10. Design and drawing of Flexible coupling

Laboratory Course Outcomes:

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

CO1: List out the various 2D and 3D CATIA commands
CO2: Describe construction details to draft the different design of machine elements
CO3: Demonstrate the concept of machine elements based on different material
CO4: Distinguish various types of Temporary and Permanent joints.
CO5: Select and **choose** the right strategy to draft the machine elements
CO6: Design and create the machine elements under various loading condition

190520: Automotive chassis

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Automotive chassis	190520/ 190515/190505	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Pre-requisite:

Basics of Internal combustion engines

Course Objectives:

To make the students to:

1. Understand vehicle chassis structure and components of transmission lines.
2. Understand automotive suspension system and steering system.
3. Understand the importance of conventional and advanced braking system.

Syllabus

Unit I Automotive chassis: Definition; chassis layout; types of chassis layout with reference to power plant location, steering position and drive on wheels; chassis components; chassis classification; Automotive frames: Construction; functions; loads acting; materials; types; frame cross sections; frame diagnosis and service; dimensions of wheel base; wheel track; chassis overhang and ground clearance.

Unit II Front axle & steering system: Functions, construction & types of front axle; front wheel geometry; front wheel drive; steering mechanisms; steering linkages & layout; types of steering gear boxes; power & power assisted steering; electronic steering; four-wheel steering; terminology-reversible steering, under-steering, over-steering, turning radius.

Unit III Suspension system: Need; factors influencing ride comfort; types; suspension springs-leaf spring, coil spring & torsion bar; spring materials; independent suspension; rubber suspension; pneumatic suspension; hydraulic suspension, shock absorbers-liquid & gas filled.

Unit IV Braking systems: Introduction, principles of braking; classification; brake actuating mechanisms; Drum brake- theory; principle; construction; working; Disc brake- theory, principle, construction, working; Parking brake- theory, principle; construction, types; Hydraulic system theory, principles, master-cylinder basics, wheel-cylinder basics, tubing & hoses, valves & switches, brake fluid; Power brake- theory, vacuum-booster basics, hydraulic-booster basics, electro-hydraulic booster basics; Advanced brake theories; Exhaust brake; ABS technology; factors affecting brake performance operating temperature, area of brake lining, clearance.

Unit V Wheel: Forces acting on wheels, construction of wheel assembly, types- spoke, disc & built-up wheels; wheel balancing; wheel alignment; Tyres: Static & rolling properties of tyres, construction details, types of tyres- pneumatic & hydraulic; types of tyre-wear & their causes; tyre rotation. Bearings: Functions; classification of bearings; bearing materials; automotive bearings.

Course Outcomes:

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

CO1: **List** out the various automotive chassis and Frame components.
CO2: **Describe** construction details of various types of automotive chassis and basicFunctions of subsystems in the chassis.
CO3: **Demonstrate** concept of steering mechanism and suspension system while construction of chassis and frame.
CO4: **Distinguish** various types of suspension system, brake system, steering system and wheels & tyres in the vehicles.
CO5: **Select** the suitable subsystems for a vehicle.
CO6: **Design** and create the chassis and frame.

Text Books:

1. Automobile engineering", Dr. Kripal Singh.
2. Automobile engineering" K.M. Gupta.
3. Heldt P.M., "Automotive chassis", Chilton Co., New York.
4. Giles J.G., "Steering, Suspension and tyres", Iliffe Book Co., London

List of Experiments:

1. To study and prepare report on the constructional details, working principles and operation of the **Automotive Clutches**.
2. To study and prepare report on the constructional details, working principles and operation of the **Automotive Transmission systems**.
3. To study and prepare report on the constructional details, working principles and operation of the **Automotive Drive Lines & Differentials**.
4. To study and prepare report on the constructional details, working principles and operation of the **Automotive Engine Systems & Sub Systems**.
5. To study and prepare report on the constructional details, working principles and operation of the **Automotive Suspension Systems**.
6. To study and prepare report on the constructional details, working principles and operation of the **Automotive Steering Systems**.
7. To study and prepare report on the constructional details, working principles and operation of the **Automotive Brake systems**.
8. To study and prepare report on the constructional details, working principles and operation of the **Automotive Tyres& wheels**.

Course Outcomes:

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

CO1: **List** out the various automotive chassis and Frame components.
CO2: **Describe** construction details of various types of automotive chassis and basic Functions of subsystems in the chassis.
CO3: **Demonstrate** concept of steering mechanism and suspension system while construction of chassis and frame.
CO4: **Distinguish** various types of suspension system, brake system, steering system and wheels & tyres in the vehicles.
CO5: **Select** the suitable subsystems for a vehicle.
CO6: **Design** and create the chassis and frame.

For batches admitted in Academic Session 2021-22

120515: Machine Design

Category	Title	Code	Credit -4			Theory Paper
			L	T	P	
Departmental Core-DC	Machine Design	120515/120505	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Note: Use of PSG Design Data book is permitted in exam.

Course Pre-Requisites:

1. Mechanics of Materials (Subject Code – 120302)
2. Design of Machine Elements (Subject Code - 120402)

Course Objectives: To make students:

1. Develop an ability to identify, formulate and solve design engineering problems.
2. Develop an ability to use the techniques, skills and modern design engineering tools necessary for engineering practice.
3. Demonstrate the ability to make proper assumptions, perform correct analysis while design upon various mechanical machine elements.

Syllabus

UNIT-I

Stress concentration & fatigue: Stress Concentration-causes, effect in tension, bending and torsion, mitigation, **Fatigue**- cyclic loading, endurance limit, S-N curve, concentration factor, notch sensitivity, design consideration, Goodman and modified Goodman's diagram, Soderberg's equation, Gerber's parabola, design for finite life, cumulative fatigue damage factor.

UNIT-II

Spring: Function, classification, Rate, curvature of coil, scale, resilience, material, Stresses and deflection equations of helical springs, design of compression and tension springs, torsion springs, fatigue loading on springs, surge in spring, critical load, spiral springs, design of leaf spring.

UNIT-III

Gears: Design of Spur, Helical, worm and Bevel Gears: Force analysis, Selection of material, Beam and wear strength, Form or Lewis factor, Dynamic load-Barth equation and Buckingham equation, consideration for maximum power transmitting capacity, Gear lubrication.

UNIT-IV

Sliding contact bearings:

Classification, Selection, Viscosity of Lubricants, Materials, Types, Petroff's relation, loads on bearing, Design, Advantages, Disadvantages, Limitations, Heat Dissipation.

UNIT-V

Rolling contact bearings:

Designation, Types, Friction effect, loads, Fatigue, Deflection & deformation, Selection, bearing life.

Course Outcomes: After successful completion of this course students will be able to:

CO1: **Describe** the design procedure used in automotive industry to design the engine parts

CO2: **Classify** the different types of spring, bearing and Gears
CO3: **Choose** the right strategy for designing the machine components based on material and methods
CO4: **Apply** the design procedure for solving and drafting the different design of machine elements
CO5: **Compare** the various curves and design procedure used
CO6: **Selection** of machine elements under various loading and environmental conditions.

Text Books

1. Shigley, J.E., and CharlesMechanical Engineering Design; TMH
2. Bhandari VB, Design of Machine elements; Tata McGraw Hill Book Co.

Reference Books

1. John KC,Text Book of Machine Drawing; PHI Learning.
2. Machine Design by Mubeen, Pearson.
3. Engineering design by George Dieter; McGraw Hill.
4. Bhatt, ND,Machine Drawing; Charotar.
5. Kulkarni, S.G., Machine Design, McGraw Hill.
6. Narayana and Reddy,Machine Drawing; New age publication.
7. Design data book, PSG College of Technology, Coimbatore
8. Luzzader, WJ, Duff, JM,Fundamental of Engineering Drawing Interactive Graphics; PHI.
9. Mahadevan, Reddy's,Mechanical design data book;CBS Publisher.

NPTEL Link for Design of Machine Elements

https://nptel.ac.in/syllabus/112106137/

https://nptel.ac.in/downloads/112105125/

List of Experiments

1. Design and drawing of helical spring.
2. Design and drawing of Spur gear.
3. Design and drawing of Helical gear.
4. Design and drawing of Worm gear.
5. Design and drawing of bevel gear.
6. Modelling and simulation of Gear box.
7. Study of Sliding Contact Bearings and Ball bearing and its selection
8. Design and drawing of Antifriction Bearing.
9. Design and drawing of Journal Bearing.
10. Assembly drawing of the Foot step bearing.

Laboratory Course Outcomes: After the completion of the course Lab students will be able to

1. **Design** and analysis the different part of an I.C Engine like Gear, Spring and Bearing
2. **Compare** the materials used in designing the automobile engine parts.
3. **Use** the software like AUTO CAD, CATIA and ANSYS for modelling and analysis
4. **Select** the spring for a proper application also can select the proper material of spring.
5. **Design** the different types of gear and spring also able to know their practical applications
6. **Create** a gear box for modern Automotive vehicles and can use this for the benefits of society.

120520: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-II	120520/ 120411/ 120401	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Pre-Requisite:
Engineering Graphics
Mechanics of Materials
Theory of Machines

Course Objectives: To make the students:
1. Understand the basics of synthesis of simple mechanisms.
2. Apply fundamental of mechanics to machines elements which include gear, gear train, cams etc.,
3. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Syllabus

Unit- I Gears: Classification, Terminology, Law of gearing, Forms of teeth, Tooth profile, Cycloidal and Involute tooth forms, path of contact, teeth in contact, Interference. Spur, Helical, Spiral, Worm and Bevel gears.

Unit- II Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains, Velocity Ratio. Various applications of gear trains - Motor car gear box, Differential mechanism, cyclometer mechanism etc.

Unit-III Balancing: Introduction, Balancing of rotating and reciprocating masses, Locomotive balancing, Balancing of multi cylinder in line engines, Balancing of radial engines, Direct and reverse crank method of balancing.

Unit-IV Cams and Cam Dynamics: Introduction, Classification of cams and followers, Terminology, Displacement, Velocity and acceleration diagrams for different follower motions, Synthesis of cam profiles. Cams with specified contours, Cam dynamics.

Unit-V Synthesis of Linkages: Introduction, Types, Number and Dimensional synthesis, Function Generation, Chebychev's spacing of accuracy points, Synthesis with three accuracy points of 4-bar and slider-crank mechanisms, Synthesis of crank rocker mechanisms with optimum transmission angle, Path generation.

Course Outcomes: After successful completion of this course students will be able to:

CO 1. **Identify** the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 2. **Classify** various components of machines like gear, gear train cam etc
CO 3. **Solve** numerical problems of various components of machines like gear, gear train cam etc.
CO 4. **Analyze** the forces and motion of complex systems of linkages, gears and cams.
CO 5. **Evaluate** the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.
CO 6. **Design** the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.

Text & References Books:

1. Design of Machinery by Robert L.Norton; TATA McGraw Hill.
2. Theory of Machines by S S Rattan; Tata McGraw Hill.
3. Theory of Machines by R S Khurmi; J K Gupta; S. Chand.
4. Mechanism & Machine Theory by Ashok G. Ambekar; PHI (Prentice-Hall India).
5. Theory of Machines by Sadhu Singh; Pearson Education.
6. Theory of Machines and Mechanisms by P L Ballaney; Khanna Publishers.
7. Theory of Machines by R K Bansal; Laxmi Publications.

NPTEL Link for Theory of Machines-II

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments

1. Study of various types of gears.
2. Study of various types of gear trains.
3. Balancing of rotating masses.
4. Balancing of reciprocating masses.
5. Study of kinematic synthesis of mechanisms.
6. Study of cams and followers.
7. To draw cam profile, velocity and acceleration diagrams of a given cam-follower mechanism.
8. Draw the profile of various cams with different types of followers.
9. Plot the follower displacement vs angle of cam rotation curves for changing compression spring, follower weights and cam speed.
10. Calculate the epicyclic gear ratio, input torque, holding torque and output torque.

Laboratory Course Outcomes: After the completion of the course Lab student will be able to

CO1 **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
CO2 **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO3 **Determine** the degrees-of-freedom (mobility) of a mechanism
CO4 **Apply** the fundamental principles of statics and dynamics to machinery.
CO5 **Evaluate** the dynamic forces for various machines.
CO6 **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.

Item ME10	To prepare and recommend the suggestive Experiment list/ Lab manual and list of projects which can be assigned under the 'Skill based mini-project' category in various laboratory component based courses to be offered in B. Tech. V Semester ***(for the batch admitted in 2021-22)***.

Automobile Engineering			Mechanical Engineering		
S.No.	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**
2	190513	Heat and Mass Transfer	2	120513	Heat and Mass Transfer
3	190514	Design of Machine Elements	3	120515	Machine Design
4	190520	Automotive Chassis	4	120520	Theory of Machines-II

190513/120513: Heat and Mass Transfer

Category	Title	Code	Credits -4			Theory Paper
			L	T	P	
Departmental Core-DC	Heat and Mass Transfer	190513/120513/ 120503/190503	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

List of Experiments:

1. Determination of Thermal Conductivity of Metal Rod.
2. Determination of Thermal Conductivity of Insulating Powder.
3. Measurement of Emissivity.
4. Determination of Stefan-Boltzmann constant.
5. Determination of Heat Transfer coefficient by Pin-Fin Apparatus.
6. Determination of Effectiveness of Shell and Tube heat exchanger.
7. Determination of Effectiveness of Parallel and Counter Flow Heat Exchanger.
8. Determination of Heat transfer coefficient by Forced Convection.
9. Determination of Heat Transfer coefficient during drop and film wise condensation.
10. To study the drying characteristics of different wet granular materials using natural and forced circulation in a tray dryer.
11. To determine the diffusion coefficient of liquid vapor in air by Stefan's tube.

Skill Based Projects:

1. Model for comparing the thermal conductivity of different metals
2. Model for comparing the heat transfer through a pipe when two insulated materials are used; (i) in first case the insulated material with lower thermal conductivity is wrapped next to the pipe and (ii) in second case when insulated material with higher thermal conductivity is wrapped next to the pipe
3. Model showing the phenomena of convection in fluids.
4. Model showing the comparison of heat transfer through the rectangular metallic surface using and without using fins or extended surfaces
5. Model showing the concept of radiation shields.

Lab Course Outcomes:

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

CO1: Determine the thermal conductivity of metal rod and insulating powder.
CO2: Estimate the Stefan-Boltzmann constant and measurement of emissivity.
CO3: Determine the effectiveness of various types of heat exchangers.
CO4: Evaluate the Heat Transfer coefficient in various heat transfer phenomena.
CO5: Evaluate the diffusion coefficient of liquid vapor in air by Stefan's tube.

190520: Automotive chassis

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Automotive chassis	190520/190515/ 190505	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

List of Experiments:

1. To study and prepare report on the constructional details, working principles and operation of the **Automotive Clutches.**
2. To study and prepare report on the constructional details, working principles and operation of the **Automotive Transmission systems.**
3. To study and prepare report on the constructional details, working principles and operation of the **Automotive Drive Lines & Differentials.**
4. To study and prepare report on the constructional details, working principles and operation of the **Automotive Engine Systems & Sub Systems.**
5. To study and prepare report on the constructional details, working principles and operation of the **Automotive Suspension Systems.**
6. To study and prepare report on the constructional details, working principles and operation of the **Automotive Steering Systems.**
7. To study and prepare report on the constructional details, working principles and operation of the **Automotive Brake systems.**
8. To study and prepare report on the constructional details, working principles and operation of the **Automotive Tyres& wheels.**

Skill Based Projects:

1. Study and Construction of physical model of Chassis layout and its main components.
2. Structural analysis of Chassis of a vehicle and its main components through Design tools.
3. Design, Calculation and simulation of Rack and Pinion mechanism to steer a vehicle using design tools.
4. Study and Construction of physical model of contactless braking system.
5. Study and Structural analysis of Shock absorbers for two-wheeler and four-wheeler.
6. Assembly and dismantling of automotive engine and clutch.

Lab Course Outcomes:

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

CO1: **List** out the various automotive chassis and Frame components.

CO2: **Describe** construction details of various types of automotive chassis and basic Functions of subsystems in the chassis.

CO3: **Demonstrate** concept of steering mechanism and suspension system while construction of chassis and frame.

CO4: **Distinguish** various types of suspension system, brake system, steering system and wheels & tyres in the vehicles.

CO5: **Select** the suitable subsystems for a vehicle.

CO6: **Design** and create the chassis and frame.

120515: Machine Design

Category	Title	Code	Credit -4			Theory Paper
Departmental Core-DC	Machine Design	120515/120505	L	T	P	Max.Marks-60 Min.Marks-19 Duration-2hrs.
			2	1	2	

List of Experiments

1. Design and drawing of helical spring.
2. Design and drawing of Spur gear.
3. Design and drawing of Helical gear.
4. Design and drawing of Worm gear.
5. Design and drawing of bevel gear.
6. Modelling and simulation of Gear box.
7. Study of Sliding Contact Bearings and Ball bearing and its selection
8. Design and drawing of Antifriction Bearing.
9. Design and drawing of Journal Bearing.
10. Assembly drawing of the Foot step bearing.

Skill Based Projects:

1. Finite element analysis of Helical compression spring for three wheelers automotive suspension
2. To prepare wooden model Multi Leaf spring.
3. To prepare wooden model of Gear box.
4. To prepare wooden model of Bearing.
5. Stress analysis on Spur Gear and durability study by FEA

Laboratory Course Outcomes:

After the completion of the course Lab students will be able **to**

1. **Design** and analysis the different part of an I.C Engine like Gear, Spring and Bearing
2. **Compare** the materials used in designing the automobile engine parts.
3. **Use** the software like AUTO CAD, CATIA and ANSYS for modelling and analysis
4. **Select** the spring for a proper application also can select the proper material of spring.
5. **Design** the different types of gear and spring also able to know their practical applications
6. **Create** a gear box for modern Automotive vehicles and can use this for the benefits of society.

190514: Design of Machine Elements

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Design of Machine Elements	190514/ 190504	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Note: Use of PSG Design Data book is permitted in exam.

List of Experiments

1. Design and drawing of Single, double and triple riveted joint
2. Design and drawing of Single and double strap butt joint
3. Design and drawing of Welded joint
4. Design and drawing of Socket and Spigot cotter joint
5. Design and drawing of Gib and Cotter joint.
6. Design and drawing of Knuckle joint
7. Study of Theories of failure
8. Design and drawing of Solid and hollow shaft
9. Design and drawing of Rigid coupling
10. Design and drawing of Flexible coupling

Skill Based Projects:

1. FEA of lap joint based on various geometrical parameters to study the behaviour of weld strength
2. Simulation of welding to study residual stress and distortions
3. Analysis of composite multi leaf spring using ANSYS 2020 R1
4. Heat Transfer analysis for different materials of ball bearing using ANSYS 2020 R1
5. Numerical analysis of Modified tooth in Spur Gear for increasing the performance by reducing the assembly errors and gear slippage in the axial direction during dynamic loading

Laboratory Course Outcomes:

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

CO1: **List** out the various 2D and 3D CATIA commands
CO2: **Describe** construction details to draft the different design of machine elements
CO3: **Demonstrate** the concept of machine elements based on different material
CO4: **Distinguish** various types of Temporary and Permanent joints.
CO5: **Select** and **choose** the right strategy to draft the machine elements
CO6: **Design** and create the machine elements under various loading condition

120520: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-II	120520/ 120411/ 120401	L	T	P	Max.Marks-60 Min.Marks-19 Duration-2 hrs.
			2	1	2	

List of experiments

1. Study of various types of gears.
2. Study of various types of gear trains.
3. Balancing of rotating masses.
4. Balancing of reciprocating masses.
5. Study of kinematic synthesis of mechanisms.
6. Study of cams and followers.
7. To draw cam profile, velocity and acceleration diagrams of a given cam-follower mechanism.
8. Draw the profile of various cams with different types of followers.
9. Plot the follower displacement vs angle of cam rotation curves for changing compression spring, follower weights and cam speed.
10. Calculate the epicyclic gear ratio, input torque, holding torque and output torque.

Skill Based Projects:

1. Investigation of gyroscopic couple for self-balancing vehicle
2. Understanding of balancing and alignment
3. Development of various toy mechanism
4. Understanding of Gear based quick return mechanism.
5. Investigation and understanding of geared cycle.
6. Understanding of gear mechanism used in watch.
7. Design of easy (make/use) cycle.
8. Working model of epicyclical gear train.
9. Investigation and understanding of sports cycle.

Laboratory Course Outcomes: After the completion of the course Lab student will be able to

CO1 **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
CO2 **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO3 **Determine** the degrees-of-freedom (mobility) of a mechanism
CO4 **Apply** the fundamental principles of statics and dynamics to machinery.
CO5 **Evaluate** the dynamic forces for various machines.
CO6 **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.

Item ME11	To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered ***(for the batch admitted in 2021-22)*** in online mode under ***Self-Learning/ Presentation***, in the B. Tech. ***V Semester***

Self-study courses-V Sem (July-Dec 2023)

S.No.	Name of Subject	Code	Week
1.	Foundations of Cognitive Robotics	120517/190517(i)	4
2.	Principles Of Vibration Control	120517/190517(ii)	4
3.	Welding of Advanced High Strength Steels for Automotive Applications	120517/190517(iii)	4

120517/190517(i): Foundations Of Cognitive Robotics

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Foundations Of Cognitive Robotics	120517/190517(i)	--	-	2	PPT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me84/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	18 Aug 2023	24 Sep 2023	4 Weeks

Course layout

Week 1: Introduction

Module 1: Introduction to Cognitive robotics and Human Robot Interaction
Module 2: Smart materials-I
Module 3: Smart materials-II
Module 4: Smart materials-III

Week 2: Brain physiology and neural signal transmission

Module 1: Architecture of the Brain
Module 2: Architecture of the Brain (Contd.)
Module 3: Nerve cells

Week 3: Neural modeling

Module 1: Introduction to Synchronization Models
Module 2: Synchronization Models (Contd.)
Module 3: Electroencephalography (EEG)

Week 4: Intelligence architecture

Module 1: Theories of Intelligence-I
Module 2: Theories of Intelligence-II
Module 3: Kuramoto Model
Module 4: Child-Robot Interaction

Books and references

1. Neuroscience, edited by Dale Purves, et al., published by Sinauer Associates.
2. How the body shapes the way we think-A New View of Intelligence, by Rolf Pfeifer and Josh Bongard, MIT Press.
3. Control Systems: Classical, Modern, and AI-Based Approaches, by Jitendra R. Raol, Ramakalyan Ayyagari, CRC Press.

120517/190517(ii): Principles of Vibration Control

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Principles Of Vibration Control	120517/190517(ii)	-	-	2	PPT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me85/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	18 Aug 2023	24 Sep 2023	4 Weeks

Course layout

Week 1 : Introduction to Vibration control

Week 2 : Dynamic Properties and Selection of Materials

Week 3 : Dynamic Vibration Absorbers

Week 4 : Principles of Active Vibration Control

Books and references

1. Principles of Vibration Control, A. K. Mallik, Affiliated East-West Press, India
2. Vibration Control of Active Structures, A Premount, Springer Publication.
3. Passive Vibration Control, Denys J. Mead, Wiley Publication

120517/190517(iii): Welding of Advanced High Strength Steels For Automotive Applications

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Welding Of Advanced High Strength Steels For Automotive Applications	120517/190517(iii)	-	-	2	PPT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_mm34/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
21/08/2023	15 Sep 2023	29 Oct 2023	4 Weeks

Course layout

Week 1: Introduction to physical metallurgy of advanced high strength steels

Week 2: Introduction to welding processes in automotive industries (Advanced Gas Metal Arc, Resistance Spot and Laser Welding Processes).

Week 3: Welding metallurgy of advanced high strength steels – Effect of weld thermal cycles on the stability of phases,solidification behaviour, segregation and hot cracking susceptibility.

Week 4: Mechanical properties of advanced high strength steel weldments – Tensile shear testing, HAZ softening characteristics,role of modified weld thermal cycles (post pulsing and post weld heat treatments) to improve the mechanical properties

Books and references

Nil

Item ME12 a	To review, prepare, finalize and recommend the ***Scheme of III semester*** **B. Tech. programmes (for the batch admitted 2022-23 Session)**

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
Scheme of Evaluation

(for batch admitted in academic session 2022-23)

B. Tech. III Semester (*Mechanical Engineering*)

S. No.	Subject Code	Category Code	Subject Name	Theory Slot: End Term Evaluation: End Sem Exam	Theory Slot: End Term Evaluation: [§]Proficiency in subject /course	Theory Slot: Continuous Evaluation: Mid Sem Exam	Theory Slot: Continuous Evaluation: Quiz/ Assignment	Practical Slot: End Sem. Exam.	Practical Slot: Continuous Evaluation: Lab Work & Sessional	Practical Slot: Continuous Evaluation: Skill Based Mini Project	Total Marks	Contact Hours per week: L	T	P	Total Credits	Mode of Teaching (Online, Offline, Blended)	[$$]Mode of Exam.	Duration of Exam.
1.	2100025	BSC	Engineering Mathematics-II	50	10	20	20	-	-	-	100	2*	1	-	3*	Blended	PP	2 hr
2.	2120331	DC	Mechanics of Materials	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
3.	2120332	DC	Theory of Machines-I	50	10	20	20	60	20	20	200	2	1	2	4 X	Blended	AO	2 hr
4.	2120333	DC	Metal Cutting and Machine Tools	50	10	20	20	-	-	-	100	3	-	-	3	Blended	PP	2 hr
5.	2120334	DC	Fluid Mechanics and Hydraulic Machines	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
6.	2120335	DLC	Software lab	-	-	-	-	60	20	20	100	-	-	2	1	Offline	SO	
7.	2120336	DLC	Self-learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	40	-	40	-	-	2	1	Offline	SO	
8.	200XXX	[illegible]	[illegible] (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Offline	SO	
9.	2120337	DLC	Summer Internship Project-I (Institute Level) (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO	
		Total		250	50	100	100	350	120	80	1050	11*	4*	16	23	-	-	
10.	2000001	Natural Sciences & SLPs	Engineering Physics	50	10	20	20	30	10	10	150	1	-	2	Grade	Blended	MCQ	1.5 hr
11.	2000004	MLC	Energy Management & Financing	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ	1.5 hr
12	3cccc3	NSC	Environmental Engg	50	10	20	20	30	10	10	150	1	1 -	2	Grade	Blended	MCQ	1.5 hr

[§] Proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.
[$$]MCQ: Multiple Choice Question [$$]AO: Assignment + Oral [$$]PP: Pen Paper [$$]SO: Submission + Oral

* for lateral entry students only

Mode of Teaching: Theory: Offline	Theory: Online	Theory: Blended: Offline	Theory: Blended: Online	Lab: Offline	NEC: Interactive	Mode of Examination: Theory: PP	Theory: A+O	Theory: MCQ	Lab: SO	SIP/ SLP/ NEC: SO	Total Credits
0	0	18	0	4	1	15	3	0	1	3	23
0	0	78.26	0	17.39	4.3	65.21	13	0	4.3	13	100

DEAN (ACADEMICS)
M.I.T.S
GWALIOR

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
Scheme of Evaluation

B. Tech. III Semester *(Automobile Engineering)*

(for batch admitted in academic session 2023-27)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching (Online, Offline, Blended)	$$Mode of Exam.	Duration of Exam.
				Theory Slot				Practical Slot				L	T	P				
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation									
				End Sem Exam	$Proficiency in subject /course	Mid Sem Exam	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project								
1.	2100025	BSC	Engineering Mathematics-II	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2 hr
2.	2190331	DC	Mechanics of Materials	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
3.	2190332	DC	Automotive Engines	50	10	20	20	60	20	20	200	2	1	2	4	Blended	AO	2 hr
4.	2190333	DC	Metal Cutting and Machine Tools	50	10	20	20	-	-	-	100	3	-	-	3	Blended	PP	2 hr
5.	2190334	DC	Fluid Mechanics & Hydraulic Machines	50	10	20	20	60	20	20	200	2	1	2	4	Blended	PP	2 hr
6.	2190335	DLC	Software lab	-	-	-	-	60	20	20	100	-	-	2	1	Offline	SO	
7.	2190336	DLC	Self-learning/Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	40	-	40	-	-	2	1	Offline	SO	
8.	200XXX	CLC	*Short Engaging Course (Informal Learning)	-	-	-	-	50	-	-	50	-	-	2	1	Offline	SO	
9.	2190337	DLC	Summer Internship Project-I (Institute Level) (Evaluation)	-	-	-	-	60	-	-	60	-	-	4	2	Offline	SO	
Total				250	50	100	100	350	120	80	1050	11	4	16	23	-	-	
10.	3660001	Natural Sciences & Skills	Engineering Physics	50	10	20	20	30	10	10	150	1	-	2	Grade	Blended	MCQ	1.5 hr
11.	1400005	MAC	Project Management & Financing	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ	1.5 hr

$ Proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.
$$MCQ: Multiple Choice Question $$AO: Assignment + Oral $$PP: Pen Paper $$SO: Submission + Oral

Mode of Teaching						Mode of Examination					Total Credits
Theory				Lab	NEC	Theory			Lab	SIP/ SLP/ NEC	
Offline	Online	Blended		Offline	Interactive	PP	A+O	MCQ	SO	SO	
		Offline	Online								
0	0	18	0	4	1	15	3	0	1	3	23
0	0	78.26	0	17.39	4.3	65.21	13	0	4.3	13	100

DEAN (ACADEMICS)
M.I.T.S
GWALIOR

Item ME12 b	To review, prepare, finalize and recommend the ***Syllabi (along with the Course Outcomes) of III semester*** **B. Tech. programmes (for the batch admitted 2022-23 Session)**

Automobile Engineering			Mechanical Engineering		
S.No.	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**
1	2190331	Mechanics of Materials	1	2120331	Mechanics of Materials
2	2190332	Automotive Engines	2	2120332	Theory of Machines –I
3	2190333	Metal Cutting and Machine Tools	3	2120333	Metal Cutting and Machine Tools
4	2190334	Fluid Mechanics & Hydraulic Machines	4	2120334	Fluid Mechanics and Hydraulic Machines

For batches admitted in Academic Session 2022-23

2120331/2190331: Mechanics of Materials

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Mechanics of Materials	2120331/2190331	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Pre-Requisites:

Basic Civil Engineering and Mechanics

Course Objectives: To make the students:

1. Learn the basic concepts and principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of strength of materials on engineering applications and design problems.

Syllabus

Unit- I Simple Stress and strain: Introduction, Types of stresses, Elongation of a bar, Principal of superposition of forces, Stress-strain relationship and elastic constants, Poisson's ratio; Thermal stresses.
Strain Energy: Strain energy due to direct stress, simple shear, torsion and bending in beams.
Unit-II Compound stress-strain: Estimation of stresses on an inclined plane by analytical and graphical method (Mohr's circle method) for plane stress and plane strain, Principal stresses, Maximum shear stress calculations
Unit-III Stresses in beams: Shear Force & Bending Moment diagram, theory of simple bending, Section Modulus, bending Stresses.
Slope and deflection: Equation of Elastic Curve, Macaulay's Method, Area Moment Method, Strain Energy Methods etc.
Unit- IV Shear stress distribution: Variation of shear stress, Shear stress distribution in rectangular, circular, triangular and I-sections
Shafts: Torsion of circular shaft, stress concentration in shafts; series and parallel combination.
Unit -V Column and Struts: Euler's theory of column, Rankine's formula, slenderness ratio; strut with eccentric load.
Thin cylinder: Stress and Strain in thin cylinder, wire wound thin cylinder; thin spherical shells.

Course Outcomes: After successful completion of this course students will be able to:

CO-1 **Identify** various structural elements and its application.

CO-2 **Illustrate** different types of stress and strain on various types of structural elements like beam, shaft column etc.

CO-3 **Calculate** principal stresses, maximum shearing stress, and the different stresses acting on a structural member.

CO-4 **Analyze** stresses and deflection for beam, shaft, long columns, thin cylinder etc.

CO-5 **Select** appropriate materials in design considering engineering properties, sustainability, cost and weight.

CO-6 **Design** simple bars, beams, and circular shafts to meet desired needs in terms of strength and deformation.

Text & Reference Books

1. Strength of Materials (MoM) by R S Lehri and A S Lehri; S K Katariya and Sons Pub.
2. Strength of Materials by S S Rattan; McGraw Hill Pub.
3. Mechanics of Materials by F P Beer, E R Johnston, J T DeWolf; TATA McGraw Hill Pub.
4. Strength of Materials by S. Timoshenko; D Van NostrandCompnay,
5. Mechanics of Solids by Mubeen; Pearson Education Pub
6. Strength of Materials by S Ramamrurtham, R Narayan; DhanpatRai sons Pub.

NPTEL Link for Mechanics of Material

https://onlinecourses.nptel.ac.in/noc18_ce04/preview

LIST OF EXPERIMENTS

1. To Study Universal Testing Machine
2. To perform the Tensile test on metal specimen
3. To perform the Compression test on metal specimen
4. To perform Bending test on metal specimen
5. To perform single shear and double shear on UTM
6. To perform Hardness testing with Brinell hardness
7. To perform Hardness testing with Rockwell hardness
8. To study the impact testing machine and perform the IZOD impact test
9. To Perform Charpy impact test
10. To study and Perform Fatigue test
11. To study Bending Moment Diagram
12. To Study stiffness of spring and Modulus of rigidity of spring wire
13. Study of weight measurement using strain gauge

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Evaluate** the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test.

CO2. **Conduct** the torsion test to determine the modulus of rigidity of given specimen.

CO3. **Perform** compression tests on spring and wood.

CO4. **Justify** the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.

CO5. **Determine** elastic constants using flexural and torsion tests.

CO6. **Examine** the stiffness of the open coil and closed coil spring and grade them.

For batches admitted in Academic Session 2022-23

2190332: Automotive Engines

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Automotive Engines	2190332/190313/ 190303/BAUL 304	2	-	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Objectives:

To make the students:

1. Understand the working of engine and its subsystems
2. Enhance their knowledge about the fuel supply system of SI engines and CI engines
3. Understand the combustion phenomenon in engines and different combustion chambers.

Syllabus

UNIT I CONSTRUCTION AND OPERATION OF ENGINES

Constructional details of four stroke spark ignition (SI) and compression ignition (CI) engines working principles. Two stroke SI and CI engines – construction and working.Comparison of SI and CI engines, four stroke and two stroke engines.Valve and port timing, timing diagram, firing order.Otto, diesel and dual cycles.

UNIT II FUEL SYSTEMS

Air fuel ratio requirements of SI engines, Air fuel ratio and emissions, working of a simple fixed venturi carburetor, starting, idling, acceleration and normal circuits of carburetors, Constant vacuum carburettor.Petrol injection. LPG and CNG fuel systems MPFI systems for petrol. Diesel fuel injection systems- Requirements, Air and solid injection, function of components, Jerk pumps, distributor pumps, pintle and multihole nozzles, Unit injector andcommon rail injection systems.

UNIT III COMBUSTION AND COMBUSTION CHAMBERS

Combustion in SI and CI engines and stages of combustion. Dependence of ignition timing on load and speed. Knock in SI and CI engines.

Combustion chambers for SI and CI engines. Direct and indirect injection combustion chambers for CI engines. Importance of Swirl, squish and turbulence. Factors controlling combustion chamber design.

UNIT IV SUPERCHARGING, TURBOCHARGING AND ENGINE TESTING

Supercharging and Turbocharging, Different methods of turbocharging, Intercooling, Turbocharger controls including, waster gate, variable geometry, variable nozzle types. Dynamometers, Indicated thermal, brake thermal and volumetric efficiencies.

Measurement of friction, Cylinder pressure measurement. Variables affecting engine performance. Methods to improve engine performance. Heat balance. Performance Maps and Drivability Diagnosis.

UNIT V COOLING AND LUBRICATION SYSTEMS

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

Course Outcomes:

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

CO1: **State** various types of engines based on required applications.

CO2: **Explain** the concepts of Internal Combustion Engine working and its industrial applications.

CO3: **Solve** analytical problems of Internal Combustion Engines.

CO4: **Compare** different types of Engines depending on their behavior and their merits and demerits.

CO5: **Select** proper Engine for appropriate applications.

CO6: **Evaluate** the performance parameters of various Engines.

Text & References Books:

1. Internal Combustion Engines by V. Ganesan, 2007, Tata McGraw Hill
2. Ramalingam K.K., "Internal Combustion Engines", Sci-Tech Publications, 2005.
3. Advanced Engine Technology by Heisler, SAE Publication.
4. Edward F. Obert Internal Combustion Engines.
5. H.N. Gupta Fundamentals of Internal Combustion Engines by, PHI.
6 .Mathur and Sharma Intendamental Combustion Engines DhanpatRai and Sons2002.

NPTEL Link for Automotive Engines

http://nptel.ac.in/courses/112104033/

List of Experiments (Expandable)

1. Study of dynamometers.
2. Valve timing diagram of single cylinder SI Engine.
3. Study of various types of fuel injectors and nozzzles
4. Performance and emissions test on multi-cylinder on SI Engine.
5. Heat balance sheet on multi cylinder SI Engine.
6. Morse test on Multi-cylinder SI Engines.
7. Study of carburetion and injection system.
8. Study and performance test of two stroke petrol engine.
9. Study and performance test of four stroke petrol engine.
10. Study and performance test of two stoke diesel engine.
11. Study and performance test of four stroke diesel engine.
12. Study of different parts of IC engine.

For batches admitted in Academic Session 2022-23

2120332/120313/190411: Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-I	2120332/120313/ 120303/ 190411/190401	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Pre-Requisite:
Engineering Graphics
Mechanics of Materials

Course objectives: To make the students:

1. Familiarize with different types of mechanisms.
2. Understand the basics of synthesis of simple mechanisms.
3. Apply fundamental of mechanics to machines which include engines, linkages etc.

Syllabus

Unit-I Mechanism: Machine, Mechanism, Kinematics Links, Pairs, Chains, Degree of freedom. Mechanisms and its Inversions; Slider, Double Slider and 4 bar mechanism. Lower pair mechanisms: pantograph, Straight line motions. Davis and Ackerman Steering Mechanisms.

Unit-II Kinematic Analysis: Displacement, velocity and acceleration analysis of plane mechanisms; relative velocity, instantaneous centre, Kennedy's Theorem, Klein's construction methods. Coriolis component.

Unit-III Dynamic Analysis: D'Alembert's principle. Equivalent dynamic system, Graphical and analytical methods of dynamic forces, analysis of mechanisms and machines including reciprocating engines.
Flywheel: Introduction, Turning-moment diagrams and Flywheel analysis.

Unit-IV Brakes: Analysis of simple brake assuming uniform pressures and uniform wear, band brake, block brakes, internal and external shoe brakes, braking of vehicles.
Clutches: Single plate and multi plate clutches, cone clutches, centrifugal clutches.
Dynamometers: Different types and their applications.

Unit-V Governors: Introduction, Types of governors, Various gravity and spring-controlled governors, governor characteristics, Effort and power of a governor, Controlling force diagrams, Coefficient of insensitiveness.

Gyroscopes: Gyroscopic couple, Effect of Gyroscopic couple on the stability of four wheel and two-wheel vehicles, Aeroplanes and Naval ships, Gyrostabilisers.

Course Outcomes: After successful completion of this course students will be able to:

CO 1.Identify basic mechanisms in real life applications.

CO 2.Discuss about mechanics of various machines.

CO 3.Apply fundamental principles of statics and dynamics to machinery.

CO 4.Analyze various types of motions and mechanisms of machinery.

CO 5.Compare various components suitable for different applications e.g. different types of governor, clutch, brakes, flywheel etc.

CO 6.Create the mechanism or components to justify the demands of work.

Text & Reference Books:

1. Theory of Machines by Rattan, SS, TMH full detail of publicaiton
2. Theory of Machine by Norton, RL; TMH
3. Theory of Machine byBallaney, PL;Kanna Pub.
4. Mechanism and Machine Theory by Ambekar, AG; PHI.
5. Theory of Mechanism and Machines by Sharma, CS and Purohit K; PHI.
6. Theory of Machines by Bevan, Thomos; Pearson/ CBS PUB Delhi.
7. Mechanism and Machine Theory byRao, JS and Dukkipati; NewAge Delhi.
8. Theory of Machines byLal,Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines byGhosh,A.,Mallik,AK; Affiliated East West Press,Delhi.

NPTEL Link for Theory of Machines-I

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments (expandable)

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.
3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutches
8. Study of various types of brakes
9. Study of various types of dynamometers
10. Use virtual lab for any two experiments
11. Determine the gyroscopic effect of a rotating disc
12. Determine the Coriolli's component of acceleration
13. Find the total slip, creep, velocity ratio and coefficient of friction between belt and pulley system.
14. Measure the percentage slip at fixed belt tension by varying load on brake drum

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Design** and **analyze** mechanism required for the specified type of motion.

CO2. **Draw** inversions and determine velocity and acceleration of different mechanisms.

CO3. **Construct** different types of cam profile for a given data.

CO4. **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.

CO5. **Compare** the various components related to machines and mechanism.

CO6. **Determine** the degrees-of-freedom (mobility) of a mechanism.

For batches admitted in Academic Session 2022-23

2120333/2190333: Metal Cutting and Machine Tools

Category	Title	Code	Credit: 3			Theory Paper
			L	T	P	
Departmental Core-DC	Metal Cutting and Machine Tools	2120333/ 2190333/ 120413	3	-	-	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

Course Objectives: To make the students understand:

1. The fundamental knowledge and principles in material removal processes.
2. The fundamentals and principles of metal cutting to practical applications through
3. The fundamentals of machining processes and machine tools.

Syllabus

Unit-I Mechanics of Metal Cutting: Introduction to manufacturing and machining, Classification of metal removal processes, Geometry of single point cutting tool and tool angles. Tool nomenclature. Conversion of tool angles from one system to another, Mechanics of chip formation and types of chips, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting. **Machinability & Cutting Fluids:** Concept and evaluation of machinability, tool life, mechanism of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Advanced Cutting Tool Materials, Cutting Fluids

Unit-II General Purpose Machine Tool: Constructional detail of milling, shaper and planer machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation. Capston and turret Lathes, single and multiple spindle automates, operations, planning and tool layout.

Unit-III Abrasive Processes & surface Finishing: Abrasive, natural and synthetic, manufacturing nomenclature. Selection of grinding wheels, wheel mounting and dressing. **Surface Finish:** Elements of surface roughness, evaluation and representation and measurement of surface roughness, relationship of surface roughness to production methods.

Unit-IV Gear Manufacturing Processes: Introduction, materials, methods of gear manufacturing, Gear Milling, Gear Hobbing& Gear Shaping Machine Tools and processes. Modern gear manufacturing methods, gear inspection.

Unit-V Non-Conventional machining: Benefits, general application and survey of Non-conventional machining processes. Mechanism of metal removal, tooling and equipment and specific applications of EDM, LBM, EBM, ECM, USM, AJM, WJM, AWJM, PAM processes

Course Outcomes: After successful completion of this course students will be able to

CO1: apply cutting mechanics to metal machining based on cutting force and power consumption.

CO2: operate lathe, milling machines, drill press, grinding machines, etc.

CO3: select cutting tool materials and tool geometries for different metals.

CO4: choose appropriate machining processes and conditions for different metals.

CO5: optimize parameters for material removal in unconventional machining processes.

CO6: identify the process parameters, their effect and applications of different processes

Text Books

1. Fundamentals of Metal Cutting and Machine Tool by Boothroyd Geofery; McGH, Kogakuha Ltd.
2. Production Technology by Jain, R.K. and Gupta, S.C; Khanna Publishers.

Reference Books:

1. Workshop Technology by Chapman, Volume I, II, & III, ELBS.
2. Production Technology by HMT; McGraw Hill, New Delhi.

For batches admitted in Academic Session 2022-23

2120334/2190334: Fluid Mechanics and Hydraulic Machines

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Fluid Mechanics and Hydraulic Machines	2120334/ 2190334/ 120314/ 190314	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Course Objectives: To make the students understand:

1. Fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. And give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. And develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

Course Pre-Requisite:
Basic Mechanical Engineering.

Syllabus

Unit-I Properties of fluid: Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity Newton's law of viscosity and its applications.
Fluid Static: Pressure variation with depth, pressure measurement, pressure on immersed surface centre pressure, Buoyancy, flotation, stability of floating bodies.
Unit-II Fluid Kinetics: One dimensional flow approximation, control volumes concept, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle, stream line, path line. Rotation, vorticity and circulation. Stream function and velocity potential function. Flow net, Free and forced vortex flow.
Unit-III Fluid Dynamics: Momentum theorem, Impulse momentum equation and its application, Euler's equation in 3-D, Bernoulli's equation for incompressible fluid flow, engineering applications of energy equation, Pitot -Tube, Venturi meter, Orifice meter.
Unit-IV Flow through Pipes: Critical Reynolds's number, velocity distribution in pipes, friction factor. Moody's chart, Laminar flow through pipe, Hagen-Poiseulli's equation, Turbulent flow through pipe, Hydraulic gradient line and total energy line. Minor head losses in pipes, Pipe Networking and Transmission of power through pipes.
Unit-V Water Turbine and Pump: Impulse and Reaction principles, Pelton, Francis and Kaplan turbines, velocity diagrams, Work done by turbines, Draft Tube theory. Application of dimensional analysis, similarity to turbines and pumps, Classification, advantage over reciprocation type, definition of manometric head gross head, static head, vector diagram and work done. Performance and Characteristics of turbines and pumps.

Course Outcomes: After successful completion of this course students will be able to:

CO1: **Define** the fundamental properties of fluids.
CO2: **Relate** the concepts of mechanics with various laws of fluid mechanics.
CO3: **Identify** the laws of fluid mechanics applicable for the body in various fluids under different conditions.
CO4: **Analyse** various forces and their effects, related to fluids mechanics.
CO5: **Measure** and compare losses in different fluid flow conditions.

CO6: **Compare** different turbo machines depending on their behaviour and their merits and demerits

Text &Reference Books:

1. Fluid Mechanics by Streeter &Wylis; McGraw-Hills Pub.
2. Fluid Mechanics by Modi& Seth; Standard publishing house.
3. Fluid Mechanics by D.S. Kumar ;Katson publisher.
4. Fluid Mechanics by R.K. Bansal; Laxmi Publishing House.
5. Fluid Mechanics byYunus A Cengel& John M. Cimbala; Tata McGraw Hill Edition.

NPTEL Link for Fluid Mechanics and Hydraulic Machines

http://nptel.ac.in/courses/112105171/1

List of Experiments:

1. To find out coefficient of discharge of a given Venturimeter.
2. To determine the hydraulic coefficient C_v , C_c , and C_d of an Orifice
3. To study the flow over a Rectangular notch to find the coefficient of discharge for it.
4. To determine the coefficient of friction for pipes of different sizes.
5. Experimental determination of Metacentric height of a ship model
6. Study of Redwood viscometer.
7. To study of different types of flow (Reynold's experiment).
8. To verify Bernoulli's Equation Experimentally.
9. To study the performance characteristics of a centrifugal pump and to determine the characteristic with maximum efficiency.
10. To conduct load test on Pelton Wheel Turbine and to study the characteristics of Pelton wheel turbine.
11. To conduct load test on Francis turbine and to study the characteristics of Francis turbine.
12. To study the characteristics of a Kaplan turbine.
13. To study the performance characteristics of a reciprocating pump and to determine the characteristic with maximum efficiency

Laboratory Course Outcomes: After successful completion of this course students will be able to:

CO1: Conduct experiment with flow measurement devices like Venturi meter and orifice meter.

CO2: Estimate the friction and measure the frictional losses in fluid flow.

CO3: Predict the coefficient of discharge for flow through pipes.

CO4: Evaluate pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.

CO5: Calculate the Critical Reynolds's Number through Pipe Set Apparatus.

CO6: Apply thermodynamic concepts to analyze Fluid machines.

2120335/2120335: Software Lab

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	
Departmental Lab Core-DLC	Software Lab	2120335/ 2120335/ 120315/ 190315	-	-	2	Max.Marks-60 Min.Marks-19

Course Pre-Requisites:
Engineering Graphics
Course Objectives: To make the students:

1. Develop an ability to make familiar with 2D, 3D modelling and simulation software
2. Develop an ability to create and modify complex 2D and 3D entities using CATIA software
3. Develop creative skills in developing new ideas.

SYLLABUS:

Auto CAD: Auto CAD interface, work space setting, Basic commands, viewports and printing.
Snaps: snap to grid, show to grid. Orthographic polar snap, object snap, dynamic UCS.
2D and 3D commands: Trim, extend, Offset, move, mirror, scale, rotate, extrude, union, subtract etc. commands. Units: properties, measure and dimension.

CATIA concepts: Display-Tree appearance, Three button move, view tool bar, Normal standard and shading view, 2D toolbar, sketch tools, constraint, profile, operation.
Toolbar: Sketch based features toolbar, commands-Pad, Pocket, shaft, groove, holerib etc. Dress up feature, Transformation features, Boolean operation.

Simulation: Assembly and simulation in CATIA, Linear and rotational motion, Nut-bolt mechanism simulation

Course Outcomes: After successful completion of this course students will be able to:
CO1 Describe AutoCAD and CATIA toolbars
CO2 Summarize 2D and 3D commands
CO3 Solve real time problems using AutoCAD and CATIA software
CO4 Analyse various mechanical engineering problems.
CO5 Evaluate technical drawings of machine assemblies as a design engineer
CO6 Generate 2D and 3D solid models with new features in machine elements

Text Books and Reference books:

1. Franke& Roger: Modelling and simulation for chemical engineering, Willey Interscience
2. Luyben-Process modelling simulation and control for chemical engineers, IInd, McGraw Hill,1989
3. Fundamentals of Engineering drawing Interactive graphics by Luzzader WJ, Duff JM;PHI
4. A general guide to computer aided design and drafting-CAD by Duggal, Vijay, cadd primer; CAD malimax publications.

Item ME13	To review, prepare, finalize and recommend the list of experiments/ Lab manual and skill based mini projects for various laboratory courses to be offered in III Semester ***(for the batch admitted in 2022-23)***.

For batches admitted in Academic Session 2022-23

Automobile Engineering			Mechanical Engineering		
S.No.	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**
1	2190331	Mechanics of Materials	1	2120331	Mechanics of Materials
2	2190332	Automotive Engines	2	2120332	Theory of Machines –I
4	2190334	Fluid Mechanics & Hydraulic Machines	4	2120334	Fluid Mechanics and Hydraulic Machines

2120331/2190331: Mechanics of Materials

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Mechanics of Materials	2120331/2190331	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

LIST OF EXPERIMENTS

1. To Study Universal Testing Machine
2. To perform the Tensile test on metal specimen
3. To perform the Compression test on metal specimen
4. To perform Bending test on metal specimen
5. To perform single shear and double shear on UTM
6. To perform Hardness testing with Brinell hardness
7. To perform Hardness testing with Rockwell hardness
8. To study the impact testing machine and perform the IZOD impact test
9. To Perform Charpy impact test
10. To study and Perform Fatigue test
11. To study Bending Moment Diagram
12. To Study stiffness of spring and Modulus of rigidity of spring wire
13. Study of weight measurement using strain gauge

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Evaluate** the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test.

CO2. **Conduct** the torsion test to determine the modulus of rigidity of given specimen.

CO3. **Perform** compression tests on spring and wood.

CO4. **Justify** the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.

CO5. **Determine** elastic constants using flexural and torsion tests.

CO6. **Examine** the stiffness of the open coil and closed coil spring and grade them.

2190332: Automotive Engines

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Automotive Engines	2190332/190313/ 190303/BAUL 304	2	-	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

List of Experiments (Expandable)

1. Study of dynamometers.
2. Valve timing diagram of single cylinder SI Engine.
3. Study of various types of fuel injectors and nozzzles
4. Performance and emissions test on multi-cylinder on SI Engine.
5. Heat balance sheet on multi cylinder SI Engine.
6. Morse test on Multi-cylinder SI Engines.
7. Study of carburetion and injection system.
8. Study and performance test of two stroke petrol engine.
9. Study and performance test of four stroke petrol engine.
10. Study and performance test of two stoke diesel engine.
11. Study and performance test of four stroke diesel engine.
12. Study of different parts of IC engine.

Skill Based Projects:

1. Engaging and disengaging engine from transmission through clutch using scrap engine material.
2. To prepare wooden model Connecting rod.
3. To prepare wooden model piston and piston pin.
4. To prepare a model showing the transmission system of two wheelers.
5. To prepare wooden model crank shaft.

Lab Course Outcomes:

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

CO1: **State** various types of engines based on required applications.
CO2: **Explain** the concepts of Internal Combustion Engine working and its industrial applications.
CO3: **Solve** analytical problems of Internal Combustion Engines.
CO4: **Compare** different types of Engines depending on their behavior and their merits and demerits.
CO5: **Select** proper Engine for appropriate applications.
CO6: **Evaluate** the performance parameters of various Engines

For batches admitted in Academic Session 2022-23

2120332/120313/190411: Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Theory of Machines-I	2120332/120313/ 120303/ 190411/190401	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2 hrs.

List of experiments (expandable)

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.
3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutches.
8. Study of various types of brakes.
9. Study of various types of dynamometers.
10. Use virtual lab for any two experiments.
11. Determine the gyroscopic effect of a rotating disc.
12. Determine the Coriolli's component of acceleration.
13. Find the total slip, creep, velocity ratio and coefficient of friction between belt and pulley system.
14. Measure the percentage slip at fixed belt tension by varying load on brake drum

Skill Based Projects:

1. Design and Fabrication of a Universal Coupling (Hooke's Joint)
2. Design and Fabrication of Agricultural Cutter Using 4 Bar mechanism.
3. Design and Fabrication of Air Compressor Using Crank and Slotted Link Mechanism
4. Design and Fabrication of Industrial Conveyor Using Four Bar Mechanism
5. Design and Fabrication of sliding RAM by using quick return mechanism.

Lab Course Outcomes:

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

CO1. **Design** and **analyze** mechanism required for the specified type of motion.
CO2. **Draw** inversions and determine velocity and acceleration of different mechanisms.
CO3. **Construct** different types of cam profile for a given data.
CO4. **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.
CO5. **Compare** the various components related to machines and mechanism.
CO6. **Determine** the degrees-of-freedom (mobility) of a mechanism.

For batches admitted in Academic Session 2022-23

2120334/2190334: Fluid Mechanics and Hydraulic Machines

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Fluid Mechanics and Hydraulic Machines	2120334/ 2190334/ 120314/ 190314	2	1	2	Max.Marks-60 Min.Marks-19 Duration-2hrs.

List of Experiments:

1. To find out coefficient of discharge of a given Venturimeter.
2. To determine the hydraulic coefficient C_v, C_c, and C_d of an Orifice
3. To study the flow over a Rectangular notch to find the coefficient of discharge for it.
4. To determine the coefficient of friction for pipes of different sizes.
5. Experimental determination of Metacentric height of a ship model
6. Study of Redwood viscometer.
7. To study of different types of flow (Reynold's experiment).
8. To verify Bernoulli's Equation Experimentally.
9. To study the performance characteristics of a centrifugal pump and to determine the characteristic with maximum efficiency.
10. To conduct load test on Pelton Wheel Turbine and to study the characteristics of Pelton wheel turbine.

Skill Based Projects:

1. Project to calculate the Meta centric height for different objects.
2. Project to define the concept of forced vortex and free vortex.
3. Project to demonstrate the working of Air Impulse Turbine.
4. Project to show the meaning of Hydrostatic Forces in Plane surface.
5. Project to show the meaning of Hydrostatic Forces in curved surface.

Laboratory Course Outcomes: After successful completion of this course students will be able to:

CO1: **Conduct** experiment with flow measurement devices like Venturi meter and orifice meter.

CO2: **Estimate** the friction and measure the frictional losses in fluid flow.

CO3: **Predict** the coefficient of discharge for flow through pipes.

CO4: **Evaluate** pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.

CO5: **Calculate** the Critical Reynolds's Number through Pipe Set Apparatus.

CO6: **Apply** thermodynamic concepts to analyze Fluid machines.

Item ME14	To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered ***(for the batch admitted in 2022-23)*** in online mode under ***Self-Learning/ Presentation***, in the ***III Semester***

Self-study courses-III Sem (July-Dec 2023)

S.No.	Name of Subject	Code	Week
1.	Manufacturing Processes - Casting And Joining	2120336/2190336(i)	4
2.	Understanding Design	2120336/2190336(ii)	4
3.	Product Design and development	2120336/2190336(iii)	4

2120336/2190336(i): Manufacturing Processes - Casting and Joining

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Manufacturing Processes - Casting And Joining	2120336/2190336(i)	-	-	2	PPT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me90/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	18 Aug 2023	24 Sep 2023	4 Weeks

Course layout

Week 1: Casting: Introduction; Classification of casting processes; Advantages and drawbacks; Historical background; Foundry practice on video; Casting of BMW car wheels on video; Patterns; Shrinkage and Mechanical allowances; Moulds; Gating system; Properties of moulding sand; Gating design; Vertical gating: aspiration effect; Optimum riser design;

Week 2: Solidification of pure metal and alloy; Solidification time: Chvorinov's rule; Categories of metal casting processes; Steps in sand casting; Mould properties and characteristics; Shell moulding; Investment casting: Process characteristics, Process to show through video, Advantages and disadvantages; Multiple mould casting, Steps in permanent mould casting; Die casting: Hot and Cold Chamber die casting; Centrifugal casting; Continuous casting; Cost analysis of casting; Casting defects; Product design considerations in casting;

Week 3: Joining Processes: Preamble, classification of joining processes; Welding: advantages and limitations; Joints in welding; Fusion welding processes; Heat density; Comparison among welding processes; Features of a Fusion Welded Joint; Typical Fusion Welded Joints; Heat Affected Zone; Solidification of Weld; Solid-State (Phase) Welding: Forge welding, butt welding, friction welding, explosion welding, resistance welding;

Week 4: Ultrasonic welding: process characteristics and applications; Electron beam welding; Laser beam welding; Plasma arc welding; Arc welding: characteristics; Consumable and non-consumable electrodes; Power source; Shielded metal arc welding: Principles and applications; Gas metal arc welding; Gas Tungsten Arc Welding; Tungsten-Inert Gas Welding (TIG); Submerged Arc Welding; Gas Welding: Principles, types of flames; Brazing and Soldering: Process capabilities; Welding defects;

Books and references

1. A.Ghosh and Asok Mallik - Manufacturing Science
2. G.K.Lal and S.K.Choudhury - Fundamental of Manufacturing Processes
3. Richard Flinn - Fundamentals of Metal Casting

2120336/2190336(ii): Understanding Design

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Understanding Design	2120336/2190336(ii)	-	-	2	PPT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_de19/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	18 Aug 2023	24 Sep 2023	4 Weeks

Course layout

Week 1 :
Module 1- An Introduction to Design,
Module 2- Users and Context
Week 2 :
Module 3-Design and Society,
Module 4 - Design and Sustainability
Week 3 :
Module 5 - Design and Industry,
Module 6 - Design and collaboration
Week 4 :
Module 7 - Innovation by Design

Books and references

1. Ansell, C & Torfing J (eds) (2014). Public Innovation through Collaboration and Design. London and New York: Routledge.
2. Antonneli, Paola (2005). Humble Masterpieces: everyday marvels of Design. Harper Collins Publishers.
3. Baxter, Mike (1995). Product Design. London Glasgow New York: Chapman & Hall.
4. Brown, Dan M (2013). Designing Together. New Riders.
5. Doordan, Dennis (ed) (2000). Design History: An Anthology. Cambridge, London: MIT Press.
6. Heskett, John (2002). Design: a very short introduction. Oxford University Press.
7. Geist, Valerius (1978). Life Strategies, Human Evolution, Environmental Design: towards a biological theory of health . New York, Heidelberg, Berlin: Springer-Verag Lawson, Brian (2006).
8. How Designer's Think: The design process demystified. Routledge.
9. Highmore, Ben (ed) (1975). The Design Culture Reader. London and New York: Routledge.

2120336/2190336(iii): Product Design and development

Category	Title	Code	Credit - 1			Internal Evaluation
			L	T	P	
Self-study courses	Product Design and development	2120336/2190336(iii)	-	-	2	PT presentation/ Report Writing

SWAYAM/NPTEL Link for the course: https://onlinecourses.nptel.ac.in/noc23_me123/preview

The details of the course are mentioned below:-

Course Start Date	Course End Date	Exam date	Duration
24/07/2023	18 Aug 2023	24 Sep 2023	4 Weeks

Course layout

Week1: Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process,Product analysis.

Week 2: Value engineering in product design;· Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function.Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

Week 3: Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA,Ergonomics in product design,.

Week 4: DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS

Books and references

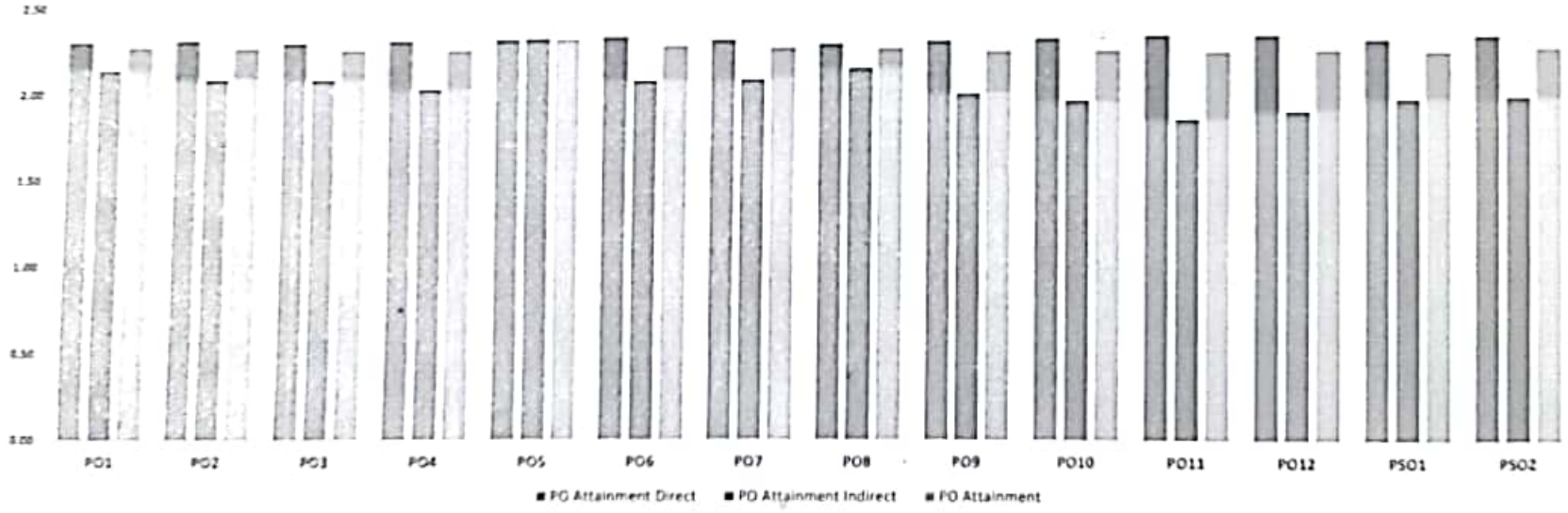
Nil

S No.	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
1	Mathematics-II (100001)	2.09	2.26	1.97	2.29	2.14	2.26	1.64	2.23	2.04	2.45	2.23	2.25	2.11	
2	Material Science (120301)	2.46	2.45	2.40	2.34	2.34	2.45	2.49	2.53	2.42	2.46	2.47	2.46	2.45	2.45
3	Mechanics of Materials (120302)	2.01	2.00	1.90	1.82	1.80	1.98	2.04	1.78	2.01	2.15	2.00	1.95	1.98	2.01
4	Theory of Machines-1 (120303)	1.92	1.97	1.95	1.90	1.93	2.01	1.95	1.96	2.30	2.05		1.93	1.87	1.92
5	Fluid Mechanics and Hydraulic Machines (120304)	1.99	1.99	1.94	2.01	1.65	2.07	2.07	2.07	1.76	1.70	2.12	2.07	1.99	2.09
6	Mechanics of Materials lab (120302 P)	2.12	2.14	1.96	2.08	1.96	2.13	2.11	1.96	2.07	2.21	1.96	2.07	2.14	2.07
7	Theory of Machines-1 Lab (120303 P)	2.33	2.39	2.56	2.32	2.52	2.39	2.46	2.25	2.78	2.23		2.39	2.36	2.27
8	Fluid Mechanics and Hydraulic Machines Lab (120304 P)	2.59	2.60	2.54	2.64	2.52	2.62	2.62	2.62	2.56	2.48	2.75	2.62	2.60	2.59
9	Software lab (120305 P)	2.53	2.45	2.49	2.40	2.30	2.47	2.44	2.48	2.47	2.57	2.50	2.47	2.45	2.47
10	Self-Learning/Presentation Lab (120306 P)	2.22	2.22	2.38	2.28	2.14	2.26	2.20	2.17	1.97	1.97		2.29	2.22	2.21
11	Summer Intership Program (120307 P)	2.40	2.38	2.58	2.38	2.54	2.38	2.38	2.38	2.37	2.50	2.30	2.38	2.38	2.46
12	Mathematics-III (100003)	2.42	2.42	2.42	2.44	2.42	2.41	2.42	2.43	2.42	2.48	2.42	2.42	2.42	2.42
13	Cyber Security (100004)	2.59	2.74	2.56	2.79	2.67	2.56	2.52	2.70	2.61	2.79	2.50	2.58	2.55	2.56
14	Theory of Machines –II (120401)	2.20	2.07	2.17	2.19	2.55	2.16	2.06	2.18	2.16	2.10	2.26	2.17	2.26	2.18
15	Design of Machine Elements (120402)	2.54	2.56	2.54	2.56	2.58	2.64	2.49		2.54	2.52	2.55	2.56	2.54	2.54
16	Manufacturing Process (120403)	2.65	2.65	2.66	2.65	2.68	2.66	2.69		2.65	2.64	2.66	2.65	2.64	2.65
17	Engineering Thermodynamics (120404)	2.69	2.67	2.71	2.65	2.73	2.74	2.64	2.67	2.68	2.71	2.61	2.67	2.68	2.69
18	Theory of Machines –II lab (120401 P)	2.76	2.76	2.76	2.77	2.76		2.76	2.76	2.77	2.77	2.76		2.76	2.77
19	Design of Machine Elements lab (120402 P)	2.12	2.06	2.05	2.22	1.96	2.26	1.97	1.94	2.10	2.10	2.26	2.08	2.11	2.14
20	Production Lab (120403 P)	2.52	2.54	2.43	2.49	2.50	2.58	2.75		2.52	2.54	2.75	2.49	2.47	2.47
21	120501: Industrial Engineering	2.19	2.18	2.20	2.17	2.26	2.19	2.19	2.25	2.19	2.18	2.20	2.20	2.18	2.19
22	120502: Metal Cutting and Machine Tools	2.30	2.29	2.26	2.19	2.26	2.33	2.34	2.23	2.31	2.19	2.24	2.30	2.32	2.30
23	120503: Heat and Mass Transfer	2.30	2.28	2.28	2.31	2.16	2.28	2.30	2.39	2.29	2.35	2.36	2.31	2.31	2.29
24	120504: Thermal Engineering	1.97	1.99	2.06	1.95	1.99	2.11	2.01	1.95	2.18	1.97		1.97	2.06	2.02
25	120505: Machine Design	2.51	2.60	2.52	2.46	2.54	2.66	2.50	2.65	2.65	2.55	2.47	2.53	2.50	2.49
26	120506: Minor Project-I (DLC-3)	2.26	2.28	2.25	2.25	2.26		2.26	2.26	2.30	2.26	2.28	2.20	2.20	2.29
27	120507: Summer Internship Project-II (DLC-4)	2.17	2.07	2.30	2.17	2.37	2.16	2.01	2.18	2.24	2.23	2.08	2.20	2.18	2.17
28	120508: Self-learning/Presentation(SWAYAM/NPTEL/ MOOC	2.30	2.28	2.26	2.30	2.35	2.33	2.25	2.28	2.31	2.43	2.26	2.29	2.29	2.29
29	120503(P) : Heat and Mass Transfer lab	2.29	2.29	2.24	2.29	2.29	2.21	2.28	2.28	2.24	2.29		2.29	2.26	2.27
30	120504(P): Thermal Engineering lab	2.03	2.02	2.03	2.04	2.03	2.03	2.02	2.11	2.02	2.03	2.04	2.03	2.04	2.04
31	120505(P) : Machine Design lab	2.42	2.42	2.43	2.40	2.43	2.42	2.39		2.37	2.44	2.33	2.44	2.32	2.42
32	120601: Advanced Production Technology	2.40	2.40	2.42	2.45	2.42	2.31			2.40	2.40	2.45	2.40	2.40	2.40
33	120611: Vibration and Noise Engineering	2.18	2.14	2.15	2.09	1.99			2.20	2.16	2.42	2.06	2.21	2.64	2.64
34	120612: Statistical Quality Control	2.19	2.28	2.18	2.32	2.22	2.23	2.10	2.10	2.10	2.10	2.24	2.22	2.07	2.27
35	120613: Work Study and Ergonomics	2.38	2.33	2.35	2.33	2.59	2.28	2.36	2.37	2.49	2.36	2.39	2.37	2.18	2.38
36	120614: Turbo Machinery	2.53	2.53	2.58	2.58	2.54	2.52	2.54	2.62	2.52	2.52	2.53	2.58	2.52	2.72
37	900101 (OC-1): Robotics	2.21	2.22	2.16	2.19	2.18	2.18	2.27	2.27	2.56	2.28	2.27	2.21	2.16	2.21
38	900102 (OC-1): Product Design	2.04	2.03	2.06	2.06	2.16	2.10	2.06	2.11	2.01	2.04	2.04	2.04	1.96	2.01
39	120601(P) : Advanced Production Technology lab	2.53	2.53	2.52	2.64	2.51	2.48	2.54	2.76	2.51	2.59	2.52	2.61	2.57	2.62
40	100007: Disaster Management	2.08	2.10	2.07	2.10	2.07	2.09	2.02	2.04	1.99	2.04	2.02	2.10	2.11	2.08
41	120605: Minor Project-II	2.05	1.98	2.13	2.10	2.78	2.23	2.12	2.35	2.02	2.06	2.17	2.07	1.67	1.97
42	120711: Refrigeration and Air-conditioning	2.36	2.37	2.38	2.35	2.34	2.36	2.38	2.39	2.36	2.35	2.38	2.37	2.40	2.36
43	120712: Basic of Finite Element Analysis	2.10	2.06	2.02	2.18	2.10	2.13	2.04	2.04	1.93	1.87	2.04	2.12	2.02	2.10
44	120713: Metrology, Measurement and Control	2.10	2.31	1.83	1.95	2.22	.		1.50	2.11	1.78	1.98	2.10	2.07	2.07
45	120714: Total Quality Management	2.21	2.21	2.13	2.15	2.09	1.85	2.04		1.95	2.19	2.00	2.14	2.10	2.09
46	900203: INDUSTRIAL AUTOMATION	2.04	2.04	1.99	2.15	2.02				2.04	2.02	2.15	2.04	2.04	2.02

47	900204: SOLAR ENERGY	2.24	2.22	2.19	2.26	2.26	2.25	2.19	2.18	2.19	2.20	2.19	2.24	2.17	2.24
48	900214: Engineering Materials for Industrial Applications	2.19	2.24	2.24	2.19	2.15	2.20	2.19	2.24	2.20	2.26	2.19	2.22	2.29	2.19
49	900215: Maintenance Engineering	2.21	2.21	2.16	2.20	2.07	2.19	2.22		2.04	2.26	2.03	2.21	1.99	2.07
50	100008: Intellectual Property Rights (IPR)	2.33	2.33	2.34			2.41	2.46	2.46		2.19	2.46	2.54		2.39
51	120701: Reliability and Vibration Lab	2.33	2.36	2.30	2.30	2.30	2.42	2.38		2.35	2.39	2.35	2.40	2.35	2.35
52	120702: Summer Internship Project III	2.61	2.60	2.61	2.61	2.61	2.62	2.60		2.58	2.61	2.58	2.62	2.58	2.58
53	120703: Creative Problem Solving	2.44	2.43	2.32	2.38	2.45	2.63	2.61		2.41	2.48		2.71	2.44	2.39
54	120801: Internship Project	2.61	2.61	2.61	2.60	2.59	2.61	2.72	2.67	2.58	2.60	2.63	2.61	2.61	2.57
55	120802: Professional Development	2.50	2.50	2.48			2.38	2.54	2.54		2.31	2.54	2.50		1.92

Column1														
PO Attainment Direct	2.30	2.31	2.29	2.30	2.31	2.32	2.31	2.28	2.30	2.31	2.32	2.31	2.28	2.30
PO Attainment Indirect	2.14	2.08	2.08	2.03	2.31	2.08	2.08	2.15	1.99	1.95	1.84	1.88	1.94	1.96
PO Attainment	2.27	2.26	2.25	2.25	2.31	2.27	2.26	2.26	2.24	2.24	2.22	2.23	2.21	2.23

PO Attainment Mechanical Batch 2018-22



Item ME15	To Review, prepare and recommend the scheme structure, Syllabi (along with the Course Outcomes), list of experiments/ Lab manual and skill based mini projects for various laboratory courses **of *I semester* B. Tech. programmes (for the batch admitted in 2023-24 Session)**

B. Tech. I Semester *(Mechanical Engineering)*

(for batch admitted in academic session 2023-24)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	$^{\$\$}$Mode of Exam.	Duration of Exam.
				Theory Slot				Practical Slot										
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation									
				End Sem. Exam	$^{\$}$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project		L	T	P				
1.	2100011	BSC	Engineering Mathematics-I	50	10	20	20	-	-	-	100	3	1	-	4	Offline	PP	2 Hrs
2.	2160122	ESC	Computer Programming	50	10	20	20	40	30	30	200	2	1	2	4	Blended	AO	2 Hrs
3.	2100021	ESC	Basic Mechanical Engineering	50	10	20	20	-	-	-	100	2	1	-	3	Blended	MCQ	1.5 Hrs
4.	2100022	ESC	Basic Electrical and Electronics Engineering	50	10	20	20	40	30	30	200	2	1	2	4	Blended	MCQ	1.5 Hrs
5.	2100020	ESC	Basic Civil Engineering and Mechanics	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2 Hrs
6.	2120026	ESC	Basic Mechanical Engineering Lab	-	-	-	-	40	30	30	100	-	-	2	1	Offline	SO	-
Total				**250**	**50**	**100**	**100**	**120**	**90**	**90**	**800**	**11**	**05**	**06**	**19**	-	-	-
7.	3000003	Natural Sciences & Skills	Environmental Engineering	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ	1.5 Hrs
Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.																		

$^{\$}$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject Natural Sciences & Skills: Engineering Physics / Engineering Chemistry / Environmental Engineering / Language
Credits of Natural Sciences & Skills will be added in the VI Semester
$^{\$\$}$MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper **SO:** Submission + Oral

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
4	-	14	1	7	4	7	1	19
21%	-	73.68%	5%	36.8%	21%	36.8%	5%	Credits %

DEAN (ACADEMICS)
M.I.T.S
GWALIOR

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
Scheme of Evaluation

B. Tech. I Semester *(Automobile Engineering)*

(for batch admitted in academic session 2023-24)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	$^{\$\$}$Mode of Exam.	Duration of Exam.
				Theory Slot				Practical Slot										
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation			L	T	P				
				End Sem. Exam	$^{\$}$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project								
1.	2100011	BSC	Engineering Mathematics-I	50	10	20	20	-	-	-	100	3	1	-	4	Offline	PP	2 Hrs
2.	2160122	ESC	Computer Programming	50	10	20	20	40	30	30	200	2	1	2	4	Blended	AO	2 Hrs
3.	2100021	ESC	Basic Mechanical Engineering	50	10	20	20	-	-	-	100	2	1	-	3	Blended	MCQ	1.5 Hrs
4.	2100022	ESC	Basic Electrical and Electronics Engineering	50	10	20	20	40	30	30	200	2	1	2	4	Blended	MCQ	1.5 Hrs
5.	2100020	ESC	Basic Civil Engineering and Mechanics	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP	2 Hrs
6.	2120026	ESC	Basic Mechanical Engineering Lab	-	-	-	-	40	30	30	100	-	-	2	1	Offline	SO	-
Total				**250**	**50**	**100**	**100**	**120**	**90**	**90**	**800**	**11**	**05**	**06**	**19**	**-**	**-**	**-**
7.	3000003	Natural Sciences & Skills	Environmental Engineering	50	10	20	20	30	10	10	150	1	-	2	GRADE	Blended	MCQ	1.5 Hrs
Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.																		

$^{\$}$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject Natural Sciences & Skills: Engineering Physics / Engineering Chemistry / Environmental Engineering / Language
Credits of Natural Sciences & Skills will be added in the VI Semester
$^{\$\$}$MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper **SO:** Submission + Oral

Mode of Teaching				Mode of Examination				Total Credits
Theory			Lab	Theory			Lab	
Offline	Online	Blended	Offline	PP	AO	MCQ	SO	
4	-	14	1	7	4	7	1	19
21%	-	73.68%	5%	36.8%	21%	36.8%	5%	Credits %

2100021: Basic Mechanical Engineering

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Engineering Science-ESC	Basic Mechanical Engineering	2100021/100204/CEL/ MEL/CSL/EEL/ ELL/ITL/CHL/ BTL114/2X24	2	1	-	Max.Marks-60 Duration-2 hrs.

Course Objectives: To make the students:

1. Develop the fundamentals of Engineering materials, measurement and reciprocating machines.
2. Develop an ability to understand the Thermodynamic laws, steam generator and reciprocating machines for solving engineering problems.
3. Demonstrate Engines and Boiler fundamentals using models.

Syllabus

UNIT-I:

Materials: Classification of engineering material, composition of cast iron and carbon steels on iron-carbon diagram and their mechanical properties; Alloy steel and their applications; Stress-Strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness and fatigue testing of materials.

UNIT-II:

Measurement: Temperature, pressure, velocity, flow, strain, force and torque measurement, concept of measurement error & uncertainty analysis, measurement by Vernier caliper, micrometer, dial gauges, slip gauges, sine-bar and combination set; introduction to lathe drilling, milling and shaping machines.

UNIT-III

Fluids: Fluid properties, pressure, density and viscosity; pressure variation with depth, static and kinetic energy; Bernoulli's equation for incompressible fluids, viscous and turbulent flow, working principle of fluid coupling, pumps, compressors, turbines, positive displacement machines and pneumatic machines. Hydraulic power & pumped storage plants for peak load management as compared to base load plants.

UNIT-IV

Thermodynamics: Zeroth, First, second and third law of thermodynamics; steam properties, steam processes at constant pressure, volume, enthalpy & entropy, classification and working of boilers, efficiency & performance analysis, natural and induced draught, calculation of chimney height. Refrigeration, vapour absorption and compression cycles, coefficient of performance (COP).

UNIT-V

Reciprocating Machines: Steam engines, hypothetical and actual indicator diagram; Carnot cycle and ideal efficiency; Otto and diesel cycles; working of two stroke & four stroke petrol and diesel IC engines.

Course Outcomes: After successful completion of this course students will be able to:

CO1. **Define** the essential concepts of thermal, design and production used in Mechanical Engineering.
CO2. **Summarize** fundamental techniques and process used in power generating machines
CO3. **Solve** the various problems based on basic concepts of Mechanical Engineering.
CO4. **Analyze** the various gas, steam and air cycles.
CO5. **Evaluate** the problems of Steam Generator, Thermodynamics, Steam and I.C. engines
CO6. **Generate** the skills to demonstrate steam Generator and reciprocating machine in depth.

Reference Books:

1. Narula; Material Science; TMH
2. Agrawal B & CM; Basic Mechanical Engineering; TMH
3. Nag PK, Tripathi et al; Basic Mechanical Engineering; TMH
4. Rajput; Basic Mechanical Engineering;
5. Sawhney GS; Fundamentals of Mechanical Engibneering; PHI
6. Nakra and Chaudhary; Instrumentation and Measurement; TMH
7. Nag PK; Engineering Thermodynamics; TMH
8. Ganesan; Combustion Engines; TMH.

For batches admitted in Academic Session 2023-24

Basic Mechanical Engineering Lab

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	
Engineering Science-ESC	Basic Mechanical Engineering Lab	2120026	-	-	2	Max.Marks-40

sts of Experiments:

Study of vertical boilers.
Study of Locomotive boilers.
Study of Babcock and Wilcox boilers.
Study of Lancashire, Cornish and Cochran boilers.
Study of boiler mounting and accessories.
Study of 2 stroke diesel and petrol engines.
Study of 4 stroke diesel and petrol engines.
. Study of steam engines.
. Study of Lathe machine.
0. Study of Vernier and Micrometer.
1. Study of Internal Combustion Engine Parts.

Skill Based Projects:

1. Measurement and calibration using slip gauges
2. Performing energy audit using stroboscope and lux meter
3. Make a Free energy Steam Engine at home
4. Make an Air Compressor at home
5. Mini Bench Tapping machine project
6. Make a Robotic Arm
7. Tornado in a bottle
8. Make a Hydraulic Lift
9. Thermal Expansion project
10. Make a positive displacement pump
11. Make a mini thermal power plant
12. Make a fire hydrant.
13. How an airplane wing creates lift and how wind turbine blades are spun by the wind. Make a model.
14. To make a model for measuring the pressure distribution in a convergent – divergent duct to confirm Bernoulli's equation.
15. Make a digital hydraulic bench.
16. To make a model for induced draught and natural draught

Course Outcomes: After successful completion of this course students will be able to:

CO1. Define the essential concepts of thermal, design and production used in Mechanical Engineering.
CO2. Summarize fundamental techniques and process used in power generating machines
CO3. Solve the various problems based on basic concepts of Mechanical Engineering.
CO4. Analyze the various gas, steam and air cycles.
CO5. Evaluate the problems of Steam Generator, Thermodynamics, Steam and I.C. engines
CO6. Generate the skills to demonstrate steam Generator and reciprocating machine in depth.

ference Books:

Narula; Material Science; TMH
Agrawal B & CM; Basic Mechanical Engineering; TMH
Nag PK, Tripathi et al; Basic Mechanical Engineering; TMH
Rajput; Basic Mechanical Engineering;
Sawhney GS; Fundamentals of Mechanical Engibneering; PHI
Nakra and Chaudhary; Instrumentation and Measurement; TMH
Nag PK; Engineering Thermodynamics; TMH
Ganesan; Combustion Engines; TMH

For batches admitted in Academic Session 2023-24

2100014: Engineering Graphics

Category	Title	Code	Credit-3			Theory Slot
			L	T	P	
Engineering Science-ESC	Engineering Graphics	2100014/100014	2	1	-	Max.Marks-60 Min.Marks-19 Duration-2hrs.

Course Objective:

1. To inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.
2. To impart knowledge about principles/methods related to projections of one,two and three dimensional objects.

Syllabus:

Unit - 1

Introduction and scale: Basics of instruments, Lettering and dimensioning, Plane geometrical constructions. Plain and diagonal scale - Representative fraction, Unit conversion and Exercises based on linear, area, volume and speed. Scale of chord.

Engineering curves: Cycloidal curves - cycloid, epicycloid and hypocycloid curve, tangent and normal. Spiral curves - Archimedean and logarithmic spiral curves. Tangent & normal on the curves. Involute curve.

Unit - 2

Projection of points: Introduction, types of projections, quadrant system, positions of points and Exercise.

Projection of straight line: Introduction, Orientation of a straight line, Traces of a line and Exercise.

Unit - 3

Projection of planes: Introduction, Types of planes, Traces of planes, Position of planes and Exercise.

Projection of solids: Introduction, Types of solids, Positions of solids and Exercise.

Unit - 4

Section of solids: introduction, Types of section planes and Anti-section and Exercise.

Development of surfaces of right solids: Introduction, Methods of development & anti-development and Exercise.

Intersection of cylinders: Introduction, methods of developments, intersection of cylinder by another cylinder and exercise.

Unit - 5

Isometric projections: Introduction, isometric scale, isometric axis, isometric view and isometric projections from orthographic views, orthographic views from pictorial view and exercise.

Computer Aided Drafting using Auto CAD: Introduction, software's basic commands, transformation and editing commands.

Course Outcomes: After successful completion of this course students will be able to:

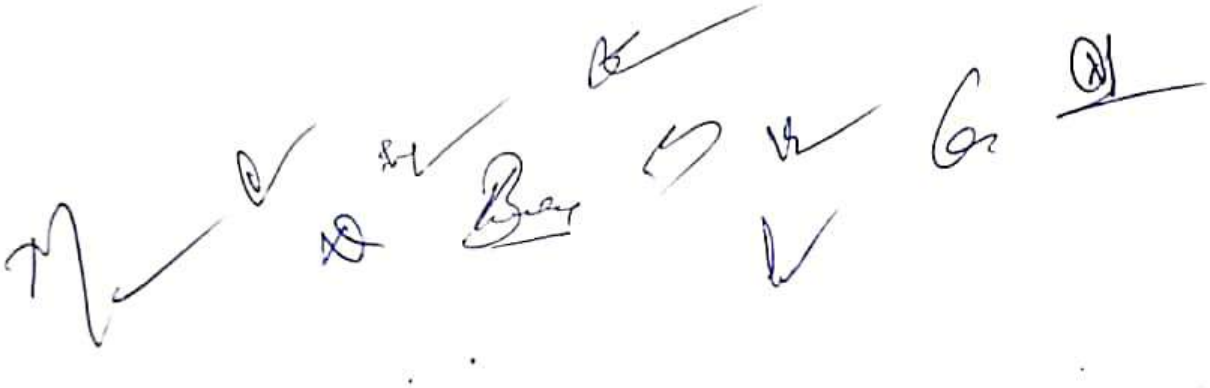
CO1. Visualize the geometric details of engineering objects.
CO2. Translate the geometric information of engineering objects into engineering drawings.
CO3. Draw orthographic projections and sections.
CO4. Develop knowledge to read, understand and explain drawing.
CO5. Improve their skills so that they can apply these skills in developing new products.
CO6. Prepare simple layout of factory, machine and buildings.

xt books:

Engineering Drawing by N. D. Bhatt, Charotar Publication Pvt. Ltd.
Engineering Drawing by P.S. Gill, S. K. kataria& sons, Delhi
Engineering Drawing by BasantAgrawal& C. M. Agrawal, Tata McGraw Hill Education Pvt. Ltd.
Engineering Graphics by K. Venugopal, New Age International Publication, India

PTEL Link for Engineering Graphics:

ttp://nptel.ac.in/courses/112103019/



Engineering Graphics Lab

Category	Title	Code	Credit-1			Practical End Sem
			L	T	P	Max.Marks-40
ESC	Engineering Graphics Lab	2100018	-	-	2	

Laboratory Work

List of Experiments:

1. To prepare sheet of Plain scale, diagonal scale and Scale of chord.
2. To prepare sheet of Cycloidal curves.
3. To prepare sheet of Projection of points and lines.
4. To prepare sheet of Projection of Planes.
5. To prepare sheet of Projection of Solids.
6. To prepare sheet of Section of Solids.
7. To prepare sheet of Development of Surfaces.
8. To prepare sheet of Isometric and Intersection of Solids

Skill Based Projects:

1. To prepare the 3D view of any object.
2. To Prepare scale for your home and make a map using this scale.
3. To prepare cut section models drawing of any object.
4. To make paper object, cut and show the development of surfaces.

Course Outcomes: After successful completion of this course students will be able to:

CO1. Visualize the geometric details of engineering objects.
CO2. Translate the geometric information of engineering objects into engineering drawings.
CO3. Draw orthographic projections and sections.
CO4. Develop knowledge to read, understand and explain drawing.
CO5. Improve their skills so that they can apply these skills in developing new products.
CO6. Prepare simple layout of factory, machine and buildings.

Text books:

1. Engineering Drawing by N. D. Bhatt, Charotar Publication Pvt. Ltd.
2. Engineering Drawing by P.S. Gill, S. K. kataria& sons, Delhi
3. Engineering Drawing by BasantAgrawal& C. M. Agrawal, Tata McGraw Hill Education Pvt. Ltd.
4. Engineering Graphics by K. Venugopal, New Age International Publication, India

2100024: Manufacturing Practices

Category	Title	Code	Credit-I			Practical End Sem
			L	T	P	
Engineering Science-ESC	Manufacturing Practices	2100024	--	-	2	Max.Marks-40

Course Objectives:

1. To familiarize with the basics of tools and equipment used in fitting, carpentry, sheet metal, welding and smithy.
2. To with the production of simple models in the above trades.
3. To develop general machining skills in the students.

Syllabus

UNIT-I

Introduction: Manufacturing Processes and its Classification, Casting, Machining, Plastic deformation and Metal forming, Joining Processes, Heat treatment process, Assembly process.

Black Smithy Shop

Use of various smithy tools. Forging operations; Upsetting, Drawing down, Fullering, swaging, Cutting down, Forge welding, Punching and drafting.

Suggested Jobs: Forging of chisel, forging of Screw Driver.

UNIT-II Carpentry Shop

Timber: Type, Qualities of timber disease, Timber grains, Structure of timber, Timber seasoning, Timber preservation. Wood Working Tools: Wood Working Machinery, joints and joinery, various operations of planning using various carpentry planes sawing & marking of various carpentry joints.

Suggested Jobs: Name Plate, Any of the carpentry joint like mortise or tennon Joint.

UNIT-III Fitting Shop:

Study and use of measuring instruments, Engineer steel rule, Surface gauges caliper, Height gauges, feeler gauges, Micrometer. Different types of files, File cuts, File grades, Use of surface plate, Surface gauges drilling tapping Fitting Operations: Chipping filling, Drilling and Tapping.

Suggested Jobs: Preparation of job piece by making use of filing, sawing and chipping, drilling and tapping operation.

UNIT-IV Foundry:

Pattern Making: Study of pattern materials, pattern allowances and types of patterns. Core box and core print, Use and care of tool used for making wooden patterns.

Moulding: Properties of good mould& Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green and bench and pit mould dry sand bench mould using single piece and split patterns.

UNIT-V Welding: Study and use of tools used for Brazing, Soldering, Gas& Arc welding. Preparing Lap & Butt joints using Gas and Arc welding methods, study of TIG and MIG welding processes. Safety precautions.

Course Outcome: After successful completion of this course students will be able to:

CO1. Discuss the hand tools, machine tools and power tools.

CO2. Utilize appropriate tools required for specific operation.

CO3. Apply safety measures required to be taken while using the tools in floor shops, Machine ships and carpentry shop.

CO4. Use the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering.
CO5. Conduct experiments in the field of Production engineering.
CO6. Design a system, components, or process to meet desired needs, ethical, health and safety, manufacturability and sustainability.

Text & References Books:

1. Bawa HS; Workshop Practice, TMH
2. Rao PN; Manufacturing Technology-Vol.1 & 2, TMH
3. John KC; Mechanical Workshop Practice; PHI
4. HazraChoudhry; workshop Practice-Vol.1 & 2.
5. Jain R. K.; Production Technology

NPTEL Link for Manufacturing Practices

http://nptel.ac.in/courses/112107145/

Laboratory Work:

Relevant shop floor exercises involving practice in forging, Carpentry, fitting, pattern making, Sand casting, Moulding, Welding, Sheet metal fabrication techniques.

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.)

A Govt. Aided UGC Autonomous & NAAC Accredited Institute, Affiliated to R.G.P.V, Bhopal

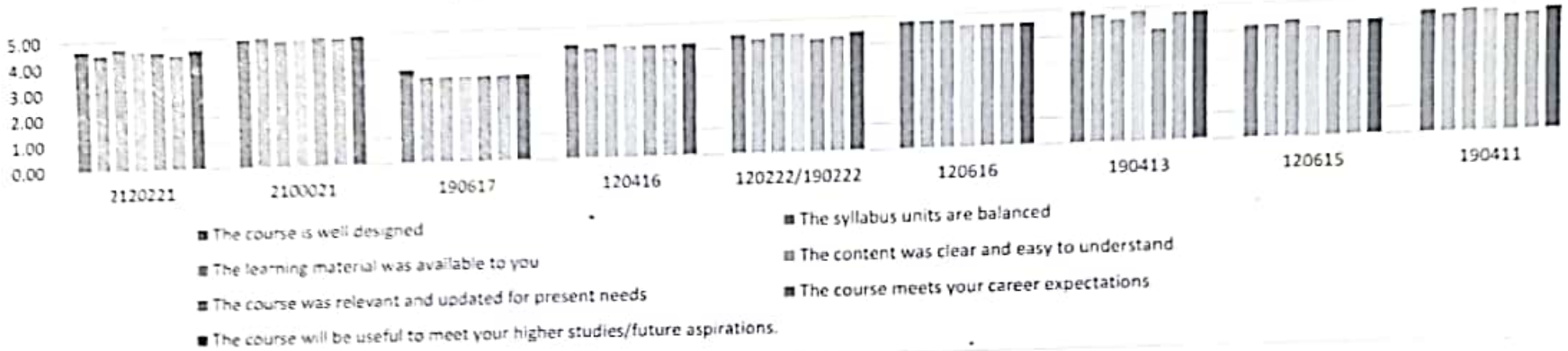
Department of Mechanical Engineering

Student's Feedback on Curriculum (BoS 2 June 2023)

Action Taken on Student's Feedback

S. No.	Subject	Feedback	Action Taken
1	Manufacturing Processes	Some current/modern nano particles type manufacturing should also be included in course	Nano particle manufacturing will be discuss in the upcoming BoS Meeting.
		Some advanced manufacturing techniques must be added	Although Such elements are available in Materials science
2	Materials Science	There Should be 3d printing course become mandatory in material science as it also involves some fundamental properties that shares with material science.	We offered 3D printing in NEC course which is mandatory for all the students.
		Syllabus required modification in composite section of the syllabus	The syllabus for the composite is enough for this subject although we offered composite materials as a DE subject through NPTEL.
3	Refrigeration and air conditioning	Industry oriented contents should be added.	In general syllabus of the subject is industry oriented but industry oriented problems will be added in the tutorial section.

Students feedback on course content_Curriculum

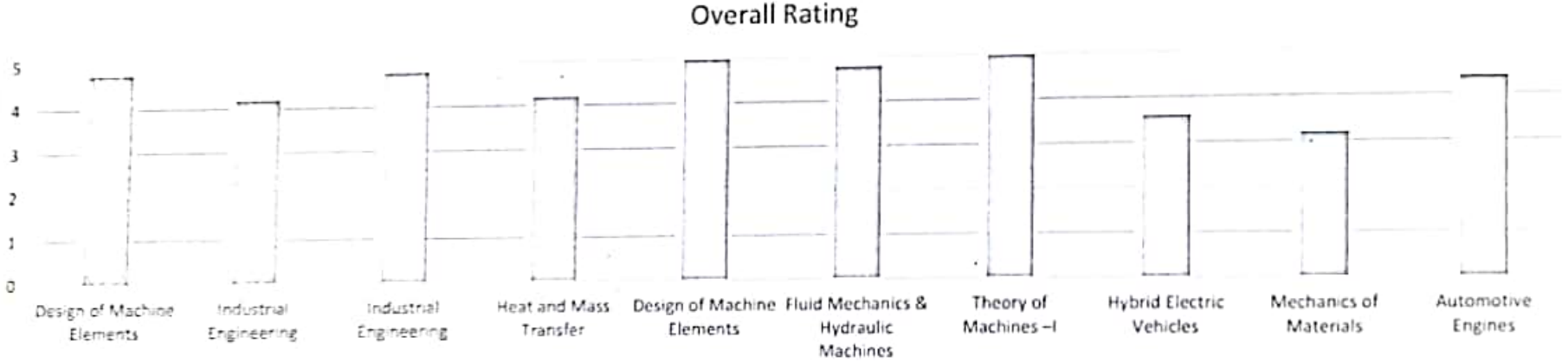


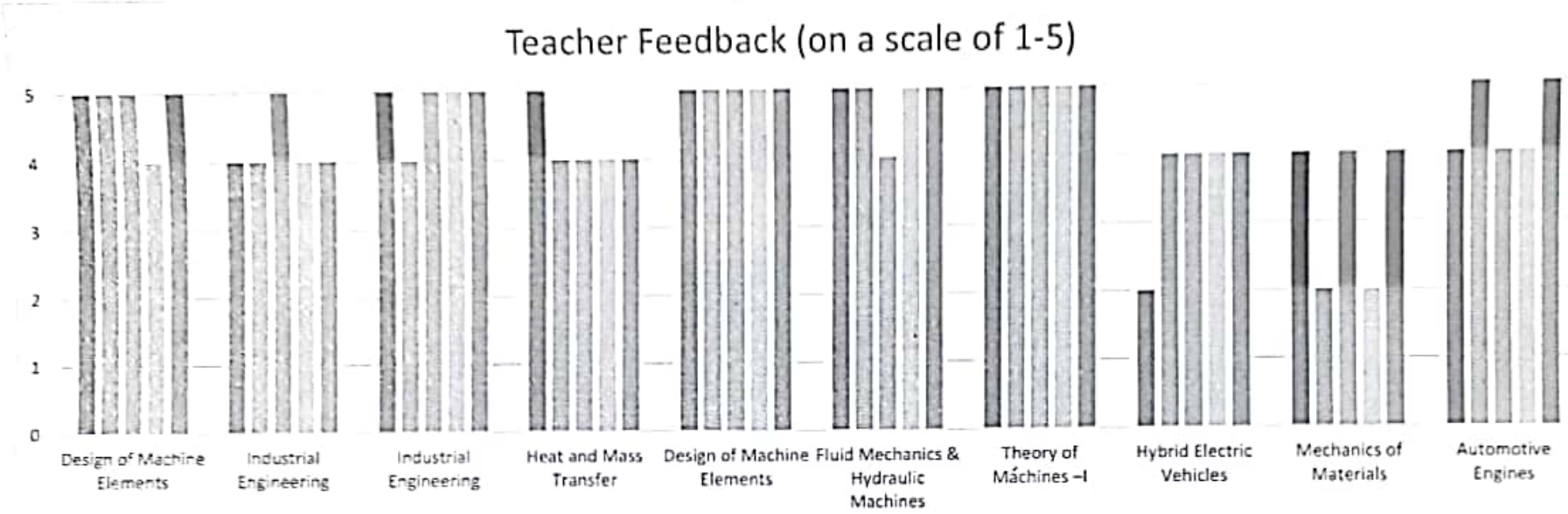
	2120221	2100021	190617	120416	120222/190222	120616	190413	120615	190411
The course is well designed	4.63	4.92	3.57	4.35	4.51	4.8	4.92	4.20	4.51
The syllabus units are balanced	4.47	4.96	3.29	4.20	4.36	4.8	4.8	4.20	4.36
The learning material was available to you	4.68	4.84	3.29	4.35	4.53	4.8	4.6	4.35	4.53
The content was clear and easy to understand	4.58	4.88	3.29	4.26	4.49	4.6	4.88	4.10	4.49
The course was relevant and updated for present needs	4.53	4.92	3.29	4.26	4.27	4.6	4.2	3.90	4.28
The course meets your career expectations	4.42	4.88	3.29	4.26	4.36	4.6	4.8	4.26	4.36
The course will be useful to meet your higher studies/future aspirations.	4.58	4.92	3.29	4.26	4.49	4.6	4.8	4.26	4.49

Teacher's Feedback on Curriculum

Action Taken on Teacher's Feedback

S.No.	Subject	Feedback	Action Taken
1	MOM	Syllabus is too vast and needed improvement as per current need	Syllabus has been modified and introduced some advanced testing in BoS
2	Mechatronics	Mechatronics subject should be include in the syllabus of Mechanical engineering	This thing will be discuss in the upcoming BoS
3	Industry 4.0	Subject Must be include in the curriculum of Me	This implementation will be done in upcoming BoS meeting, as this course will be offered to the students through NPTEL





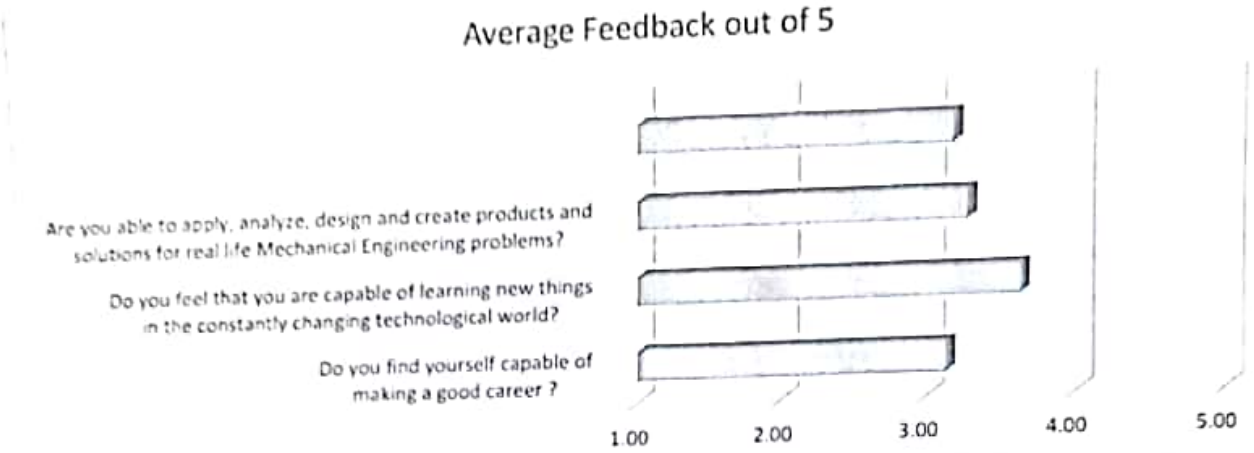
Course Name	The availability of books & E-learning material in the institute is good	The Courses and content are up to date. Please suggest if you feel any new course(s) need to be introduced to meet current needs & technological changes?	The course curriculum/syllabi are helpful in meeting the higher studies/placement requirements according to present global trends.	The course / contents in your domain/area are well designed and frequently updated, hence need no changes at present.	The curriculum is capable of inculcating life-long learning abilities in students.	Overall Rating
Design of Machine Elements	5	5	5	4	5	4.8
Industrial Engineering	4	4	5	4	4	4.2
Industrial Engineering	5	4	5	5	5	4.8
Heat and Mass Transfer	5	4	4	4	4	4.2
Design of Machine Elements	5	5	5	5	5	5
Fluid Mechanics & Hydraulic Machines	5	5	4	5	5	4.8
Theory of Machines –I	5	5	5	5	5	5
Hybrid Electric Vehicles	2	4	4	4	4	3.6
Mechanics of Materials	4	2	4	2	4	3.2
Automotive Engines	4	5	4	4	5	4.4

Alumni's Feedback on Curriculum

Action Taken on Alumni's Feedback

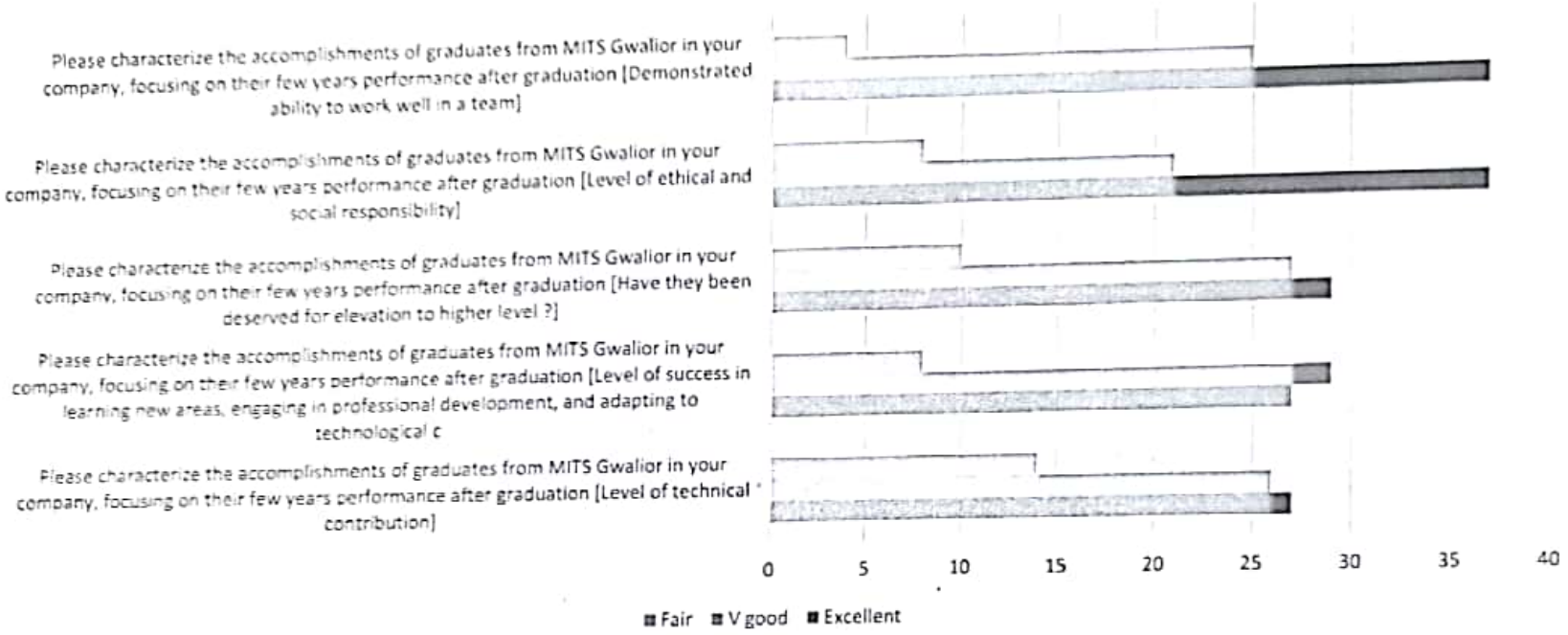
The feedback responses from alumni and action taken is illustrated in the following table:

S.No	Feedback	Action Taken
1	Industrial need should be fulfilled by employing subject related to industries	Internship in industry is offered in Mechanical VIII semester
2	MATLAB, Ansys, and simulation tool required	Curriculum updated, DE and OCs subjects are available for such courses.
3	ML should be the part of curriculum.	Data science and ML subject has been implemented
4	Students must be more flexible in co-curricular activities along with curriculum	New clubs has been started in different domain of interest to develop students personalities..
5	Practical exposure is very less. Collage not provide any campus recruitment or internship opportunity.	6 month Internship opportunity is providing in VIII sem .



Do you find yourself capable of making a good career?	3.13
Do you feel that you are capable of learning new things in the constantly changing technological world?	3.47
Are you able to apply, analyze, design and create products and solutions for real life Mechanical Engineering problems?	3.03
Do you feel that you are able to manage projects in an ethical manner and work efficiently as a member/leader of multidisciplinary teams?	3.03

Employer Feedback



tem IE21	To discuss and recommend the scheme structure & syllabi of PG Programme (M.E./M.Tech./MCA/MBA) along with their Course Outcomes (COs)

Master of Technology (Production Engineering) (Semester – I)

W.E.F JULY 2023

Scheme of Examination

S. No.	Subject Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Periods per week			Total Credits
			Theory Slot			Practical Slot		MOOCs						
			End Sem	Mid Sem	Quiz/ Assignment	End Sem	Lab work/ sessional	Assignment	Exam		L	T	P	
1.	560111	Computational Techniques	70	20	10	-	-	-	-	100	3	-	-	3
2.	560112	Production Engineering- I	70	20	10	-	-	-	-	100	3	-	-	3
3.	560118	Maintenance Management	70	20	10	-	-	-	-	100	3	-	-	3
4.	DE-I	Elective-I	70	20	10	-	-	-	-	100	3	-	-	3
5.	OC-1	*Open Category Course -1 (OC-1)	70	20	10	-	-	-	-	100	3	-	-	3
6.	560120	Production Engineering Lab-1	-	-	-	90	60	-	-	150	-	-	4	4
7.	560121	$ Self Learning / Presentation	-	-	-	-	100	-	-	100	-	-	2	2
Total			350	100	50	90	160	-	-	750	15	-	6	21

During labs, students have to perform practical/assignments/ minor projects related to theory subjects/theoretical concepts of respective semester using recent technologies / languages / tools etc.

* Open Category course (OC-1) will have to be opted from the pool of open courses (Student can opt from parent department and other department) and based on interdisciplinary aspects.

$Self learning / presentation through SWAYAM / NPTEL (Registration in a course will be compulsory for students bus assessment will be based on internal seminar presentation)

Departmental Elective –I (DE-I)	Open Category course (OC-1)
560115: Flexible Manufacturing Systems	800111: Product Design & Development
560116: Ergonomics and Work Study	800112: Computer Integrated Manufacturing
560117: Total Quality Management	
560119: Production and Operations Management	

DEAN (ACADEMICS)
M.I.T.S.
GWALIOR

560111: Computational Techniques

Category	Title	Code	Credit-3			Theory Paper
BSC	Computational Techniques	560111	L	T	P	Max.Marks-70 Min.Marks-28 Duration-3hrs.
			3	-	-	

Objective of Course

1. To know about the formulation of L.P.P. & its solution
2. To explore the Game theory
3. To describe Probability and random Process
4. To describe random sampling and hypothetical test
5. To perceive the Z-transform techniques

Syllabus

Unit- I: Concept of LPP, LPP formulation, Graphical method for solving LPP with two variables, Simplex method, Duality theory, Transportation and Assignment problems. Non Linear Programming Problems (NLPP): Introduction of NLPP, constraints and non constraint problems of maxima and minima, constraints in the form of equations, Dynamic Programming: Basic concepts, Bellman's optimality principle, dynamic programming approach in decision making problems, optimal subdivision problems.

Unit- II: Introduction, competitive games, finite and infinite games, two person zero sum game, pure and mixed strategies, saddle point, maximin and minimax principle, solution of a rectangular game in terms of mixed strategies, Graphical method of (2xm) and (nx2) games.

Unit- III: Theory of Probability: Concept of probability, Random variable, discrete probability distribution, Continuous probability distribution, Moment generating function, Probability density function, some special distribution, Random Variable: Concept of Random variable, one dimensional Random variable, two dimensional, distribution function, Joint probability distribution function, Marginal probability distribution, cumulative probability distribution.

Unit- IV: Testing of Hypothesis, Origin of the theory of sampling, chi-square (χ^2) distribution, the t-distribution, Fisher's Z-distribution, student-distribution, Analysis of variance one way classification, two-way classification.

Z-transform and their properties, inverse Z-transform, convolution theorem, solution of difference equations by Z-transform. Basic concept of Bessel's function, Hankel transform and their properties, Parseval's theorem.

Course Outcomes After completing this course, the students will be able to:

CO's	Description of CO's
CO1	Determine the solution of Linear and Non Linear Programming Problems
CO2	Evaluate the problems related to game theory.
CO3	Acquire the knowledge of Probability theory and Random Variable.
CO4	Analyze the test of hypothesis and Analysis of Variance.
CO5	Identify the concept of transform.

ımended Books:

Griva, S. G. Nash and A. Sofer: Linear and Non Linear Optimization, Society for Industrial & pplied, U. S. Mathematics , 2012.

B. Hildebrand: Methods of Applied Mathematics , Prentaince Hall, 1992.

. C. Saxena: Mathematical Statistics, S Chand, 1986.

. K. Dass: Advance Engineering Mathematics, S. Chand, 2018.

. R. Thie and G. E. Keough: An Introduction to Linear Programming & Game Theory, Wiley India rivate limited, 2008

560112: Production Engineering- I

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Core-DC	Production Engineering- I	560112	3	-	--	Max.Marks-70 Min.Marks-28 Duration-3hrs.

Course Objective: To make the student to understand:

1. the basic principles and methods utilized in the joining and welding technology of engineering materials
2. how to handle welding equipment and weld/join materials practically
3. how to analyze, implement and maintain manufacturing system
4. methods of metal casting, casting defects and Gating system
5. methods of Moulding process, pattern design

Syllabus

Unit-I Introduction: - Metal casting vis-a-vis other processes, casting problems, design and introduction of moulds, melting, refining and pouring and liquid metal. Mechanism and Rate of Solidification on Metals and Alloys: - Nucleation and growth in pure metals and alloys, Solidification, solidification in actual castings, feeding resistance, rate of solidification.

Unit-II Riser Design and Placement: - Riser designs chvorinov's caines, NRL methods, placement of risers, effects of complex section and chills, case studies.Gating Design: - Gating principles, vertical gating, aspiration effects and its prevention, bottom gating system, horizontal-gating system, and case studies.

Unit-III Mould Production and Pattern Design: - Conventional moulding and core making processes, new moulding processes viz. Cold box, hot box, and vacuum moulding etc. pattern design considerations.

Die-Castings: - Recent trends, recasting, shell, lined die casting, ferrous die-casting. Non Mould materials and mould metal reactions: Structure of silica clay, various types of bonds, mould metal reactions, recent trends such as sand deformability index, role of atmospheres etc.Casting Design Considerations and Casting Defects: - Various casting design factors, casting defects, their causes and remedies.

Unit-IV Welding Technology: - Welding as compared with other fabrication processes, classifications of welding processes, fusion and pressure welding processes, weld-ability of metals, and metallurgy of welding. Weld design, stress distribution and temperature fields in the welds. Metal transfer and melting rate, recent developments in welding, explosive welding, laser beam welding, radio frequency induction welding etc. Specific application of welding e.g. cladding, metallizing, surfacing and fabrication.

Unit-V Welding of plastics, welding defects and inspection of welds, thermal cutting of metals, processes used for thermal cutting of metals. Recent developments in thermal cutting processes, cutting of cast iron, stainless steel and non-ferrous metals. Use of thermal cutting in fabrication of process machines and pressure vessels etc. Economics of welding: welding cost, productivity, post welding operations, standard time for welding & flame cutting, standard time & cost calculations.

Course Outcome: After successful completion of this course students will be able to:

1. **Describe** the causes of welding defects and how it can be prevented.
2. **Use** the basic manufacturing methods, measurements, automation and quality control.
3. **Apply** the principles of metallurgy during the welding process.
4. **Demonstrate** safe work habits that reflect concern and care for self, others and the environment.
5. **Employ** the principles of Moulding, casting and Gating design.
6. **Perform** any of the metal joining techniques (welding, brazing and soldering) conveniently

& References Books:

- Welding Processes & Technology - Dr. R.S. Parmar, Khanna Publishers, New Delhi.
- Production Technology - R.C. Patel & C.G. Gupte, (Vol III) C. Jamnadas & Co. Mumbai
- Welding Technology & Design - V. M. Radhakrishnan, Newage International (P) Ltd, Pub. N. Delhi
- Welding Skills & Technology - Dave Smith, Gregg Division, MCGRAW- Hill Book Company
- Welding Handbook, Seventh Edition, Vol-1, Welding Processes -Arc and Gas Welding and

560113/560118: Maintenance Management

Category	Title	Code	Credit-3			Theory Paper
Departmental Core(DC)	Maintenance Management	560113/560118	L	T	P	Max. marks: 70 Min. Marks: 28 Duration: 3 hrs
			3	-	--	

Course Objectives: To make the student to understand:

1. To learn the Maintenance Management, Maintenance Planning and Scheduling ,Computerized Maintenance Management Systems
2. To learn the Maintenance Organization Structure and Policies
3. To understand the Controlling Maintenance Costs , Life Cycle Cost Concepts
4. To learn the Optimizing Spare Parts Inventory Levels and Total Productive Maintenance Concepts
5. To learn the overall configuration and Maintenance of Production Machines, Manufacturing System

Syllabus

Unit-I Introduction, Requirements: - Maintenance Engg., Maintenance Management, Types of Maintenance Break down, Preventive, Predictive, Routine, continuous Schedule. Maintenance contract, Contract Act, Repair Activity. Operating Practices to reduce Maintenance. Issues, Problems, Selection of System, Renovation. Addition, Restoration & Control.

Unit-II Maintenance Organisation: - Function. Layout. Centralized and Decentralized Maintenance. Incentives. Human Factors, Maintenance of Plant, Pre-requisites, Programmes, Strategies, Policies.

Unit-III Work Measurement in Maintenance: - Work Authorization and Contract, Rating and Evaluation. Work simplification. Estimation of Repair and Maintenance cost. Cost control for efficient operation. Small Plant Maintenance Control.

Unit-IV Maintenance Store & Inventory Control: - Store Room Materials & Standard Spares. Spares Management. Introduction to computer in Maintenance. Automation Maintenance, Information by computers. Computerized Planning and scheduling. Total Productive Maintenance. Activities, Planned Maintenance, Autonomous Effects, Evaluation Organizations, Maintenance, Aims, Steps, Total Preventive Maintenance, Zero Break down.

Unit-V Maintenance of Production Machines: - Lath m/c, Drilling m/c, Milling m/c, Welding m/c, Shaper

Course outcomes: After successful completion of this course students will be able to

1. **State** Maintenance Key Performance Indicators
2. **Use** a preventive maintenance plan and monitor its implementation and review of technical reports.
3. **Select** highest quality of production and the continuation of the workflow
4. **Implement** team based continuous improvement in Maintenance
5. **Apply** knowledge about Managing Maintenance Spare Parts and Logistics

. **Perform** maintenance orders issued by the in charge, implemented and completed in the promised time for him and to make sure the machine is clean after the maintenance process.

& References Books:

. Bikash Bhadury. 'Total Productive Maintenance". Allied Publisher Ltd. New Delhi.
2. BC langlay. "Plant Maintenance". Prentice-Hall International. New Jersey.
3. JD Pattern. Jr. "Maintainability and Maintenance Management". Instrument society of America, third edition.
4. P Gopalakrishnan and AK Banerji, "Maintenance and Spare Parts Management". Prentice-Hall of India (P) Ltd. New Delhi.

560119/560114: Production and Operations Management

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective -DE	Production and Operations Management	560119/560114	L	T	P	Max.Marks-70 Min.Marks-28
			3	-	-	Duration-3hrs.

Course Objective: To make the student to understand:

1. The role of operations management in the overall business strategy of the firm
2. Principles and applications relevant to the planning, design, and operations of manufacturing firms
3. How Enterprise Resource Planning and MRPII systems are used in managing operations
4. Layout planning, assembly line balancing and Inventory control system
5. The application of operations management policies and techniques to the service sector as well as manufacturing firms

Syllabus

Unit-I Introduction: - Functions within business organizations: Production, finance, marketing and other functions. The production management functions; design and operation of production system. Classification of production systems.

Forecasting: - Features common to all forecasts. Approaches to forecasting. Forecasts based on judgment and opinions. Analysis of time series data. Accuracy and control of forecasts. Choosing a forecasting technique.

Unit-II Design of Production Systems: - Capacity planning- importance of capacity decisions, defining and measuring capacity, determining capacity requirements.

Location Planning: - The need for location decisions, location factors evaluating alternative location.

Unit-III Layout Planning: - Need for layout decisions, basic layout types, designing layouts, assembly line balancing, computer-aided layout planning.

Product Design: - Need for product design, research and development, diversification, simplification, evaluation, standardization, reliability.

Unit-IV Work System Design: - Job design, work measurement, method study, work sampling, standard data, PMT system, operation and control of production system: intermediate-range planning - nature and scope of aggregate planning, techniques for aggregate planning.

Inventory Management: - Requirements for effective inventory management, EOQ models, quantity discount, safety stock, inventory control systems.

Unit-V Probabilistic Inventory Models: - MRP- An overview of MRP, MRP processing, MRP outputs, benefits and limitations of MRP. MRPI, MRP-II. Scheduling & Sequencing: -

Scheduling in high-volume systems; Scheduling & Sequencing in job shops. Criteria used in job shop models.

Course Outcomes: After successful completion of this course students will be able to:

1. **Apply** core features of the operations and production management function at the operational and strategic levels, specifically the relationships between people, process, technology productivity and quality
2. **Discuss** core features of the operations and production management function at the operational and strategic levels, specifically the relationships between people, process, technology productivity and quality

- **Analyze** Forecasting technique and layout planning
- **Use** the Inventory models and job shop models in Industries
- **Apply** the 'transformation model' to identify the inputs, transformation processes and outputs of an organization
- **Describe** the boundaries of an operations system, and recognize its interfaces with other functional areas within the organization and with its external environment.

A. References Books

1. G. Free-Bell and J. Balkwill. Management in Engineering. Prentice-Hall of India (P) Ltd, New Delhi, Second edition.
2. E. S. Buffa and Sareen Production and Operations Management. New Age International (P) Ltd. New Delhi.
3. W. J. Sevanesan Production/Operations Management. Richard D Irwin Inc.
4. J. L. Riggs. Production Systems: Planning Analysis and Control. John Wiley & sons New York, forth edition.
5. Production & Operations Management by Dr KC Arora, Laxmi Publications, New Delhi.

560115: Flexible Manufacturing System

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Elective (DE)	Flexible Manufacturing System	560115	3	-	--	Max. marks: 70 Min. Marks: 28 Duration: 3 hrs

Course objectives: To make the student to understand:

1. Different types of manufacturing available today such as the Special manufacturing System, the Manufacturing Cell and the Flexible Manufacturing System
2. Material handling system, Cutting tools and tool management
3. Fundamentals of computer assisted numerical control programming and automated storage systems
4. Concept of Aggregate planning, single stage planning and multi stage planning
5. Common CAD/CAM data base organized to serve both design and manufacturing

Syllabus

Unit-I Introduction of CAD/CAM systems. Overview of FMS. System hardware and general functions.

Unit-II Material handling systems and automated storage/retrieval systems. Work holding system. Cutting tools and tool management.

Unit-III Physical planning of system, Aggregate Planning, Single stage planning & Multi stage planning.

Unit-IV Software structure functions and description. Cleaning and automated inspection. Communications and computer networks for manufacturing.

Unit-V Quantification of flexibility. Human factors in manufacturing. FMS and CIM in action. Justification of FMS. Modelling for Design. Planning and operation of FMS.

Course outcomes: After successful completion of this course students will be able to:

1. **Define** various workstations, system support equipments
2. **Identify** hardware and software components of FMS
3. **Familiarized** with single stage planning & multi stage planning
4. **Implement** planning and scheduling methods used in manufacturing system
5. **Summarize** the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing
6. **Perform** simulation on software's use of group technology to product classification

Text & References Books:

1. Mikell P. Groover, Automation, Production Systems and CIM, "PHI
2. Greenwood, "Implementation of FMS", MacMillan Edition.
3. Talavage J. "FMS in Practice, Applications, design and Simulation", Marcel Dekker Inc.
4. Ranky P.O. "Design and Operation of FMS", IPS Publications, UK.

560116: Ergonomics and Work Study

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Departmental Elective (DE)	Ergonomics and Work Study	560116/690116	3	-	-	Max.Marks-70 Min.Marks-28 Duration-3hrs.

Course Objective: To make the students to understand:

1. Concept and significance of work study and ergonomics.
2. Various techniques of work-study for improving the productivity of an organization.
3. Existing methods of working on the shop floor of an organization.
4. Allowances, rating, calculation of basic and standard time for manual operations in an organization.
5. Work place design, working postures and lifting tasks.

Syllabus

Unit -I Human being in Man Made World, Gross Human Anatomy, Anthropometrics, Static and Dynamic, Muscles and Work Physiology, Static and Dynamic Work including Maximum Capacity.

Unit-II Biomechanics, Environmental Condition including Thermal, Illumination Noise and Vibration, Biological Transducer and Nervous system including their Limitations. Control and Displays Psycho Physiological aspects of Design. Research Techniques in Ergonomics .Generation. Interpretation and application as statistical Methods. Case Analysis

Unit-III Method Study: - Selection of Problem, Application of critical examination techniques. Preparation of work Study Reports, Development of improved methods, preparation for and presentation of improved methods, implementation of improved methods, follow-up techniques and report.

Unit-IV Work Measurement: - Work Sampling. Fundamental statistical concepts sample size, procedure for making a work sampling study, determining time standards by work sampling, practical applications, advantages and disadvantages.

Unit-V Micro Motion Study. PMTS. MTM Systems work factor system and Production Incentives

Course Outcome: After successful completion of this course students will be able to:

1. **Identify** potential and current OH&S hazards in the workplace relating to ergonomics issue.
2. **Describe** relation between human motion and industry.
3. **Calculate** the production capacity of man power of an organization.
4. **Analyze** the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.
5. **Devise** appropriate wage and incentive plan for the employees of an organization.
6. **Design** physical and psychosocial work system and work places.

Text & References Books:

1. Barnes Ralph M., "Motion & Time study: Design and Measurement of Work", Wiley Text Books, 2001.
2. Lakhwinder Pal Singh, "Work Study and Ergonomics" CAMBRIDGE , 2010.
3. S.K. Sharma Savita Sharma , "Work Study and Ergonomics" S K Kataria and Sons 2006.
4. P.C.Tiwari, "Work Study and Ergonomics" CRC Press , 2004.

Suresh Dalela and Saurabh Dalela, "Work Study and Ergonomics" CRC Press , 2001.
Marvin E. Mundel & David L, "Motion & Time Study: Improving Productivity", Pearson Education,2000.
Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", Mc Graw Hill, 1997.
Work Study-Shan
Work Study – Sharma

560117: Total Quality Management

Category	Title	Code	Credit-3			Theory Paper
Departmental Elective (DE)	Total Quality Management	560117/690117	L	T	P	Max. marks: 70 Min. Marks: 28 Duration: 3 hrs
			3	-	--	

Course objectives: To make the student to understand:

1. The philosophy and core values of Total Quality Management (TQM)
2. How to evaluate best practices for the attainment of total quality
3. The concept of ISO 9000 and quality manual
4. The various methods of design and development to improve quality of product
5. Impact of quality on economic performance and long-term business success of an organization

Syllabus

Unit-I Introduction to ISO 9000 and TQM: - Quality, History of Quality, Total Quality, TQM, TQM Enablers. TQM Models, Quality Control, Computer Aided Quality Control, Customer Satisfaction, Customer Drives, Quality Circles, Customer Complaints, Types of Customers, Customers, Surveys. World Class Quality Control: - Total Waste Elimination, Waste identification, Total Employees involvement, TEI Practice, Company wide quality control.

Unit-II TQM Gurus: - Deming, Juran, Crosby, Feighbaum, Ishikawa, Quality Assurance, Principles, forms,at different stages.Quality Assurance: - QA Programme, QA and top Management, QA department, Vendor rating

Unit-III Quality of Product Design and Development: - Methods for design and development, Integrated Product development, Quality of conformance, computer aided manufacturing quality.Next Generation: - Quality control in manufacturing, Quality improvement: Juran 7 Quality tools, Bench marking, types, Process, Quality leadership for TQM, TQM Implementation:- Juron Approach. Quality Organization Requirements, planning of quality organization.

Unit-IV Quality Manual for ISO 9000-2000: - QMS guideline, Management responsibility, Resource Management, Process Management, Measurement Analysis and Improvement.
Quality Cost: Evolution: - Time and Quality cost, Activity based costing, Quality cost collection, Quality cost analysis, Juran classical model for optimum quality levels.

Unit-V Quality Awards: - ISO Malcolm Baldrige National quality award, European quality awards, CII, EXIM award. ISO 14001 environment manual, ISO 18001 manual

Course outcomes: After successful completion of this course students will be able to:

1. **Discuss** about quality measures, Quality control techniques.
2. **Describe** various theories of Total quality management.
3. **Determine** the cost of poor quality and process effectiveness and efficiency to track performance quality.
4. **Apply** appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies.

Evaluate the performance excellence of an organization, and determine the set of performance indicators

Enhance management processes, such as benchmarking and business process reengineering

& References Books:

- TQM by Dr, K.C.Arora, S.K.Kataria and sons Publication, Delhi.
- Jack Hiradsky TQM Hand book McGraw Hill New York
- JH Taylor TQM Field Manual Me. Grew Hill Newyork
- Chrisk Hakes: TQM-The key to business, Chapman and Holland.
- Kim Todd, "World-class Performance", McGraw Hill, London

560118: Product Design and Development

Category	Title	Code	Credit - 3			Theory Paper
			L	T	P	
Open Category (OC)	Product Design and Development	800111	3	-	-	Max.Marks-70 Min.Marks-28 Duration-3hrs.

Course Objective:

The goal of the course is to give an introduction to multidisciplinary aspects of product development and innovation. Students will familiarize themselves with basic methodology and tools that can be used in product development projects. Practical problems will be considered in cooperation with companies in order to simulate real product development situations.

Syllabus:-

Unit 1 - Introduction, Product Development Process and Product Planning, Product life cycle concept.

Unit 2 - Product Specification Development, Product Architecture, Conceptual Design, Industrial Design.

Unit 3 - Design for Manufacturing and Assembly, Design for Environment, Robust Design.

Unit 4 - Physical Prototypes and Models and Experimentation, Human factors in design.

Unit 5 - Product Development, Economics, Patents and Intellectual Properties.

Course Outcome: - After the completion of the course the student will be able to

- **CO1.** **Analyze** the demands and needs of customers to conceptualize product.
- **CO2.** **Describe** the different steps involved in the product design.
- **CO3.** **Analyze** the shortcoming in the product development.
- **CO4.** **Identify** the opportunities to develop the product.
- **CO5.** **Utilize** the recourses available in efficient manner for maximum productivity.
- **CO6.** **Forecast** the impact of product on the surrounding environment.

Text Books and References:-

1. Kevin Otto and Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", 1/e, 2004, Pearson Education, New Delhi
2. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", Tata McGrawHill Edition, New Delhi, 2003
3. David G. Ullman, "The Mechanical Design Process", McGraw-Hill Inc., Singapore, 1992

560119: Computer Integrated Manufacturing

Category	Title	Code	Credit-3			Theory Paper
			L	T	P	
Open Category (OC)	Computer Integrated Manufacturing	800112	3	-	--	Max. marks: 70 Min. Marks: 28 Duration: 3 hrs

Course objectives: To make the student to understand:

1. To use computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
2. To learn the computer numerical control, retrofitting of conventional machine tools, programming and feedback systems.
3. To understand the different controlling system, sensors and work holding devices.
4. To learn the CNC part programming, cost of machining operations and maintenance features.
5. To learn the overall configuration and Computerized Manufacturing Planning System.

Syllabus

Unit-I Production Operations & Automation Strategies: - Automation Defined, Types of Production Systems, Production Concepts and Mathematical Model , Automation Strategies . Fundamentals of CAD/CAM/CIM.

Unit-II Numerical Control Production System: - Types of NC Systems, MCU and other components of NC System, Applications, NC-Part Programming, (Manual & Computer Assisted) APT Language, Computer-Automated Part Programming, DNC, CNC, and Adaptive Control.

Unit-III Group Technology & Flexible Manufacturing Systems: - GT Part Families, Classification & coding, M/C Cell Design, Benefits of GT, FMS Workstations, Material Handling & Storage Systems, Computer Control System, Planning of FMS Analysis Methods.

Unit-IV Industrial Robotics: - Robotics Technology, Programming & Applications.

Unit-V Computerized Manufacturing Planning System: - Computer Aided Process Planning, Computer Integrated Production Planning Systems, Shop Floor Control.

Course outcomes: After successful completion of this course students will be able to:

1. **Identify** the main elements of computer numerical control manufacturing systems.
2. **Discuss** knowledge about constructional features of CNC machine and Retrofitting of Conventional Machine Tools.
3. **Apply** control system, feedback devices, sensors and tooling in manufacturing processes.
4. **Arrange** the different machining operations in a program by using various codes and languages.
5. **Determine** the cost of machining operation of CNC and monitoring the various features to enhance the life span of the machine.
6. **Create** Process product models with CAM tools and CNC machines

Text & References Books:

. Automation, Production system and computer integrated manufacturing by M.P. Groover, PHI
. CAD/CAM by P. N. Rao, P. N. Rao, Tata McGraw Hill publication
. CAD/CAM/CIM by Bhupendra Gupta, Dhanpat Rai publication
. Computer control of machine tools by Koren Yoram, Tata McGraw Hill publication
. Manufacturing Engineering and Technology by Serope Kalpakjian, PHI publication.