List of New Course(s) Introduced

Department : *Mechanical Engineering*

Programme Name : *B.Tech.*

Academic Year : 2021-22

List of New Course(s) Introduced

Sr. No.	Course Code	Name of the Course
01.	ME203TMC02	Indian Knowledge System-I
02.	ME204TPC05	Applied Thermodynamics
03.	ME08TPE63	Additive Manufacturing
04.	ME08TOE52	Soft Computing
05.	ME08THS42	Management Information System
06.	ME08TPC13	Solar Energy
07.	IPPATC1	Research Methodology & IPR
08.	MEPATP4	Design of Thermal Systems
09.	MEPBTP5	Noise, Vibrations and Harshness
10.	MEPATP6	Computational Fluid Dynamics

विभागाध्यक्ष / Head
यांत्रिकी अभियांत्रिकी विभाग / Mechanical Engg. Dept.
प्रौद्योगिकी संस्थान / Institute of Technology
गुरु घासीदास वि.वि. / Guru Ghasidas V.V.
कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)

Minutes of Meeting

An online meeting of the Board of Studies of Mechanical Engineering was held on 30-10-2021 at 02:30 PM. The meeting was attended by the following members:

1.	Chairman, BOS Present	Prof. T. V. Arjunan Head, Dept. of Mechanical Engg.
2.	Member, Academic Expert Present	Prof. S. Murugan Dept. of Mechanical Engg., NIT Rourkela
3.	Member, BOS Present	Dr. Pankaj Kumar Gupta Assoc. Prof., Dept. of Mech. Engg.
4.	Member, BOS Present	Mrs. Shweta Singh Asst. Prof., Dept. of Mech. Engg.
5.	Member, Industry Expert Present	Mr. Vivek Singh, Executive Engineer, Damodar Valley Corporation Kodarma Thermal Power Station, Jharkhand

The scheme and course syllabi for M.Tech. (Machine Design) was discussed. With the consent of all the members, the course scheme and syllabi for M.Tech. (Machine Design) was finalized under guidelines in AICTE Model curriculum (2018), and new courses were added/modified in the list of electives. The following were the salient features discussed in the meeting:

1. Computer Aided Design course was suggested to be renamed as Advanced CAD with advanced topics included, such as introduction to Finite Element analysis.

2. The course content for Tribology now includes topics pertaining to Surface Engineering, and therefore, the course is renamed to Tribology and Surface Engineering.

3. A topic on Experimental uncertainty analysis was added in the course on Design and Analysis of Experiments.

4. The following list of New courses were added in M.Tech (Machine Design): -
   (a) Design of Thermal Systems
   (b) Computational Fluid Dynamics
   (c) Noise, Vibration & Harshness
   (d) Research methodology & IPR is included

These changes shall be effective from Academic session 2021-2022.
The detailed Scheme of Credits and Syllabi of M.Tech. (Machine Design) courses is attached herewith for reference.

30/10/2021
Prof. T. V. Arjunan
Chairman, BOS

30.10.2021
Dr.Pankaj K. Gupta
Member, BOS

30/10/2021
Mrs. Shweta Singh
Member, BOS

Dr. S. Murugan
Professor
Department of Mechanical Engineering
NIT, Rourkela

Prof. S. Murugan
Academic Expert

Email Consent Given
Mr. Vivek Singh
Industry Expert

विभागाध्यक्ष / Head
यांत्रिकी अभियांत्रिकी विभाग / Mechanical Engg. Dept.
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कोनी, बिलासपुर (छ.ग.) / Koni, Bilaspur (C.G.)

Gmail **Pankaj Kumar Gupta <pankajkgupta@gmail.com>**

Re: Approval of the BOS minutes

vivek singh <vivek.singh.dvc@gmail.com> Fri, Nov 19, 2021 at 3:08 PM
To: Pankaj Kumar Gupta <pankajkgupta@gmail.com>
Cc: s murugan <murugans@nitrkl.ac.in>, muruganresearch@yahoo.com, "T.V.Arjunan" <arjun_nivi@yahoo.com>

Dear sir,
The attcahed sylabus of M Tech. machine design and B Tech. 2nd year had been checked and found OK. Approval from my end is accorded.

With Regards
Vivek Singh
Sr. Divisional Engg. (M)
DVC KTPS

[Quoted text hidden]

Minutes of Meeting

An online meeting of the Board of Studies of Mechanical Engineering was held on 01-10-2021 at 02:15 PM. The meeting was attended by the following members:

1.	Chairman, BOS	Prof. T. V. Arjunan Head, Dept. of Mechanical Engg.	Present
2.	Member, Academic Expert	Prof. S. Murugan Dept. of Mechanical Engg., NIT Rourkela	Present
3.	Member, BOS	Dr. Pankaj Kumar Gupta Assoc. Prof., Dept. of Mech. Engg.	Present
4.	Member, BOS	Mrs. Shweta Singh Asst. Prof., Dept. of Mech. Engg.	Present
5.	Member, Industry Expert	Mr. Vivek Singh, Executive Engineer, Damodar Valley Corporation Kodarma Thermal Power Station, Jharkhand	Present

The course syllabi for 3rd and 4th semesters of B.Tech. II Year as well was discussed. Furthermore, courses for Ph.D. work in the elective's category were revised.

With the consent of all the members, the course scheme and syllabi for 3rd and 4th semesters in year B.Tech. Mechanical Engineering was finalized, and new courses were added in the list of electives for B. Tech & Ph.D. course work. The following were the salient features discussed in the meeting:

2. In the course on Engineering Thermodynamics in 3rd semester, the sequence of Modules was slightly altered without adding/deleting any content. The following list of New courses were added in B. Tech

   (a) Indian Knowledge System-I
   (b) Applied Thermodynamics
   (c) Additive Manufacturing
   (d) Soft Computing
   (e) Management Information System
   (f) Solar Energy

3. The total number of classes for teaching the B.Tech. courses was changed according to 14 weeks of working in both semesters.
4. The name of Manufacturing Science course was changed to Manufacturing Technology.
5. In the scheme of courses, all courses were re-typed in Sentence case changing from all Caps.
6. The Professional Electives offered in IV semester was dropped to equip students with fundamental core subjects. It was suggested to offer Professional Electives from the III year onwards.
7. The following list of New courses were added in the Electives category for Ph.D. course-work:

(a) Systems Engineering
(b) Advanced IC Engines Technology
(c) Fuel Cell and Electric Vehicle Technology
(d) Energy in Buildings
(e) Noise, Vibration & Harshness
(f) Waste Minimization Techniques and Applications
(g) Robotics
(h) Energy Modelling and Simulation
(i) Vibration and Control
(j) Energy Modeling & Policy Analysis
(k) Energy Resource & Modeling
(l) Renewable Energy
(m) Industrial Automation & Controls

7. It was suggested to combine the Courses – Solar Energy Engineering & Applications and Design of Solar Thermal Systems into one course.

These changes shall be effective from Academic session 2021-2022.

The detailed Scheme of Credits and Syllabi B.Tech.(Mechanical Engineering) courses and in Ph.D. course work is attached herewith for reference.

Prof. T. V. Arunan
Chairman, BOS

Dr.Pankaj K. Gupta
Member, BOS

Mrs. Shweta Singh
Member, BOS

Dr. S. Murugan
Professor
Department of Mechanical Engineering
NIT, Rourkela

Prof. S. Murugan
Academic Expert

Email Consent Given

Mr. Vivek Singh
Industry Expert

विभागाध्यक्ष / Head
यांत्रिकी अभियांत्रिकी विभाग / Mechanical Engg. Dept.
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Gmail **Pankaj Kumar Gupta <pankajkgupta@gmail.com>**

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With Regards
Vivek Singh
Sr. Divisional Engg. (M)
DVC KTPS

[Quoted text hidden]

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA(A CENTRAL UNIVERSITY)
CBCS-NEW, STUDY & EVALUATION SCHEME
PROPOSED W.E.F. SESSION 2021-2022
B.Tech. II Year (SEMESTER III)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	MA203TBS07	Statistical Methods	3	1	-	30	70	100	4
2.	ME203TPC01	Engineering Thermodynamics	3	1	-	30	70	100	4
3.	ME203TPC02	Fluid Mechanics	3	1	-	30	70	100	4
4.	ME203TPC03	Mechanics of Solids-I	3	1	-	30	70	100	4
5.	ME203TPC04	Manufacturing Processes	3	-	-	30	70	100	3
6.	ME203TMC02	Mandatory Course – Indian Knowledge System-I	1	-	-	-	-	-	-
		Total	**16**	**4**	**-**	**150**	**350**	**500**	**19**
PRACTICALS									
1.	ME203PPC01	Fluid Mechanics Lab	-	-	2	30	20	50	1
2.	ME203PPC02	Mechanics of Solids Lab	-	-	2	30	20	50	1
		Total	**-**	**-**	**4**	**60**	**40**	**100**	**2**
GRAND TOTAL			**16**	**4**	**4**	**210**	**390**	**600**	**21**

Total Credits : **21**
Total Contact Hour : **24**
Total Marks : **650**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.
L-LECTURE, T-TUTORIAL, P-PRACTICAL, ESE –END SEMESTER EXAMINATION

विभागाध्यक्ष/Head
यांत्रिकी अभियांत्रिकी विभाग/Mechanical Engg. Dept.
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गुरु घासीदास वि.वि./Guru Ghasidas V.V.
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SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA(A CENTRAL UNIVERSITY)
CBCS-NEW, STUDY & EVALUATION SCHEME
PROPOSED W.E.F. SESSION 2021-2022
B.Tech. II Year (SEMESTER IV)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	MA204TBS09	Numerical Analysis & Computer Programming	3	1	-	30	70	100	4
2.	ME204TPC05	Applied Thermodynamics	2	1	-	30	70	100	3
3.	ME204TPC06	Kinematics Of Machinery	2	1	-	30	70	100	3
4.	ME204TPC07	Mechanics Of Solid-II	3	1	-	30	70	100	4
5.	ME204TPC08	Machine Tool Technology	3	-	-	30	70	100	3
6.	ME204TPC09	Materials Science & Metallurgy	3	-	-	30	70	100	3
		Total	**16**	**4**	**-**	**180**	**420**	**600**	**20**
PRACTICALS									
1.	ME204PPC01	Manufacturing Tech. Lab	-	-	2	30	20	50	1
2.	ME204PPC02	Computer Aided Machine Drawing	2	-	2	30	20	50	3
		Total	**2**	**-**	**4**	**60**	**40**	**100**	**4**
GRAND TOTAL			**18**	**4**	**4**	**240**	**460**	**700**	**24**

Total Credits : **24**
Total Contact Hour : **26**
Total Marks : **700**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.
L-LECTURE,T-TUTORIAL,P-PRACTICAL, ESE –END SEMESTER EXAMINATION

विभागाध्यक्ष/Head
यांत्रिकी अभियांत्रिकी विभाग/Mechanical Engg. Dept.
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SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDHALAYA, (A CENTRAL UNIVERSITY)
DEPARTMENT OF MECHANICAL ENGINEERING CBCS-NEW, STUDY & EVALUATION SCHEME W.E.F. SESSION 2021-2022

Year: B.Tech. 4th year

SEMESTER- VIII

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	INTERNAL ASSESSMENT	ESE	SUB-TOTAL	
1.	ME08TPC13	Solar Energy	3	1	-	30	70	100	4
2.	ME08TPE06	Professional Elective-06	3	0	-	30	70	100	3
3.	ME08TOE05	Open Elective-05	3	0	-	30	70	100	3
4.	ME08THS04	Elective from Humanity Science HS-04	3	0	-	30	70	100	3
		Total	**12**	**1**	-	**120**	**280**	**400**	**13**
PRACTICALS									
1.	ME08LMP02	Major Project	-	-	14	120	80	200	7
Total			**0**	**0**	**14**	**120**	**80**	**200**	**7**

Total Credits: 20
Total Contact Hour: 27
Total Marks: 600
*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.
L-LECTURE,T-TUTORIAL,P-PRACTICAL, ESE –END SEMESTER EXAMINATION

ME08TPE06 Professional Elective-06
ME08TPE61 Total Quality Management
ME08TPE62 Cryogenic Engineering
ME08TPE63 Additive Manufacturing
ME08TOE05 Open Elective-05
ME08TOE51 Automobile Engineering
ME08TOE52 Soft Computing
ME08TOE53 Intellectual Property Rights
ME08THS04 Elective from Humanity Science HS-04
ME08THS41 Supply Chain Management
ME08THS42 Management Information System
ME08THS43 **Principles of Management**

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SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA(A CENTRAL UNIVERSITY)
CBCS-NEW, STUDY & EVALUATION SCHEME
PROPOSED W.E.F. SESSION 2021-2022
M.Tech. I Year (SEMESTER I)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	**MEPATT1**	Advanced Mechanics of Solids	3	-	-	40	60	100	3
2.	**MEPATT2**	Advanced Computer Aided Design	3	-	-	40	60	100	3
3.		Professional Elective-1	3	-	-	40	60	100	3
4.		Professional Elective-2	3	-	-	40	60	100	3
5.		Professional Elective-3	3	-	-	40	60	100	3
6.	**IPPATC1**	Research Methodology & IPR	2	-	-	-	50	50	2
		Total	**17**	**-**	**-**	**240**	**360**	**600**	**17**
PRACTICALS									
1.	**MEPAPT1**	Numerical Simulation Lab	1	-	2	30	20	50	2
		Total	**1**	**-**	**2**	**30**	**20**	**50**	**2**
GRAND TOTAL			**18**	**-**	**2**	**270**	**380**	**650**	**19**

Total Credits : **19**
Total Contact Hour : **20**
Total Marks : **650**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks and Assignments, Attendance etc. of 10 Marks.
L-LECTURE, T-TUTORIAL, P-PRACTICAL, ESE –END SEMESTER EXAMINATION

Professional Elective-1	Professional Elective-2	Professional Elective-3
MEPATP1-Mechanics of Composite Materials	MEPATP2-Advanced Engineering Materials	MEPATP3-Mechanical Vibrations
MEPATP4-Design of Therma Systems	MEPATP5-Design and Analysis of Experiments	MEPATP6-Advanced Mechanical Design
MEPATP7-Tribology and Surface Engineering	MEPATP8-Design for Manufacturing & Assembly	MEPATP9-Advanced Synthesis of Mechanisms

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SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA(A CENTRAL UNIVERSITY)
CBCS-NEW, STUDY & EVALUATION SCHEME
PROPOSED W.E.F. SESSION 2021-2022
M.Tech. I Year (SEMESTER II)

SN	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	SUB-TOTAL	
1.	**MEPBTT1**	Advanced Engineering Design	3	-	-	40	60	100	3
2.	**MEPBTT2**	Finite Elements in Design	3	-	-	40	60	100	3
3.		Professional Elective-4	3	-	-	40	60	100	3
4.		Professional Elective-5	3	-	-	40	60	100	3
5.		Open Elective	3	-	-	40	60	100	3
6.		Audit Course	2	-	-	40	60	100	2
		Total	**17**	**-**	**-**	**240**	**360**	**600**	**17**
PRACTICALS									
1.	**MEPBPT1**	Design Lab	1	-	2	30	20	50	2
2.	**MEPBPT2**	Modeling and Analysis Lab	1	-	2	30	20	50	2
		Total	**2**	**-**	**4**	**60**	**40**	**100**	**4**
GRAND TOTAL			**19**	**-**	**4**	**300**	**400**	**700**	**21**

Total Credits : **21**
Total Contact Hour : **23**
Total Marks : **700**

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks and Assignments, Attendance etc. of 10 Marks.
L-LECTURE,T-TUTORIAL,P-PRACTICAL, ESE –END SEMESTER EXAMINATION

Professional Elective-4	**Professional Elective-4**	**Open Elective**
MEPBTP1-Fracture Mechanics	MEPBTP2-Optimization Techniques in Engineering Design	Business Analytics
MEPBTP3-Theory of Plates and Shells	MEPBTP4-Rotor Dynamics	Operations Research
MEPBTP5-Noise, Vibrations and Harshness	MEPBTP6-Computational Fluid Dynamics	Industrial Safety
MEPBTP7-Product Design and Development	MEPBTP8-Smart Materials & Structures	Composite Materials
		Waste to Energy
		Internet of Things
		Cost Management of Engineering Projects
		MOOCs

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ME204TPC05 – APPLIED THERMODYNAMICS

1.	**Department/Center proposing the course**	Mechanical Engineering
2.	**Course title**	**Applied Thermodynamics**
3.	**L-T-P Structure**	2-1-0
4.	**Credits**	3
5.	**Course number**	ME204TPC06
6.	**Status (Category for program)**	**Professional Core**

7.	**Pre-requisites**	Engineering Thermodynamics

8.	Status vis-à-vis other courses (Give Course number/title)	
8.1.	Overlap with any UG/PG course of the Dept./Centre	Yes
8.2.	Overlap with any UG/PG course of other Dept./Centre	No
8.3.	Super cedes any existing course	Yes

9.	Not allowed for **(indicate program names)**	

10.	Frequency of offering	☐ Every sem ☐ 1st Sem ☐ 2nd Sem ☐ Either Sem: **4th sem**

11.	**Faculty who will teach the course**	Expertise or specialization in the Fluid Thermal sciences

12.	**Will the course require any visiting faculty**	No

13.	**Course contents***(about 100 words) (include laboratory/design activities)*: Properties of Pure substances, Vapour power cycles, Gas power cycles, Refrigeration Cycles, Compressible fluid flow, Kinetic theory of gases

14. **Lecture outline***(with topics and number of lectures)*

Module No.	Topics	No. of hours
1	Gas power cycles – Carnot, Stirling Ericsson, Air standard, Otto, Diesel, Dual Brayton cycles, Aircraft propulsion	9
2	Properties of pure substances, thermodynamic processes for pure substance, steam tables, charts of thermodynamic properties	8
3	Vaopur Power cycles, Rankine cycle, regenerative cycle, exergy analysis of vapor power cycles binary vapor cycles	9
4	Refrigeration cycles – reverses heat engine cycle, vapor compression, vapor absorption, gas refrigeration cycle, production of solid ice, Psychrometrics	8
5	Compressible fluid flow – stagnation properties, one dimensional steady isentropic flow, critical properties, shocks, introduction to kinetic theory of gases	8
TOTAL HOURS (including Tutorials)		42

15. Brief description of tutorial activities

Tutorial classes are for application-based problem solving

16. Suggested texts and reference materials

Text Books:

- Engineering Thermodynamics – P.K. Nag, McGraw Hill
- Basic and Applied Thermodynamics – P.K. Nag, McGraw Hill

Reference Books:

- Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, Wiley
- Thermodynamics-An engineering approach – Cengel and Boles, McGraw Hill

Course Template

1.	**Department/Center proposing the course**	Mechanical Engineering
2.	**Course title**	**Solar Energy**
3.	**L-T-P Structure**	3-1-0
4.	**Credits**	4
5.	**Course number**	
6.	**Status (Category for program)**	Professional Core

7.	**Pre-requisites**	Heat transfer

7.1.	Overlap with any UG/PG course of the Dept./Centre	No
7.2.	Overlap with any UG/PG course of other Dept./Centre	No
7.3.	Super cedes any existing course	No

8.	Not allowed for **(indicate program names)**	NA

9.	Frequency of offering	Odd Semester
10.	**Faculty who can teach the course**	Fluid-Thermal

11.	**Will the course require any visiting faculty**	No

12.	**Course objectives** *(about 50 words):* • To impart knowledge on solar energy and its conversion technologies • To understand construction and working of solar thermal collectors. • To impart knowledge about various solar thermal in domestic and industrial applications. • To understand the concept of direct conversion from solar radiation into electrical energy and developments of photovoltaic technologies. • To impart knowledge about the status of solar energy market, economic and policies in India.

13.	**Course outcomes** *(about 50 words):* • Demonstrate a basic understanding of solar energy and its conversion. • Acquire knowledge in the design and development of solar thermal collectors for domestic and industrial applications. • Acquire knowledge in design of solar photovoltaic power plant for small and medium scale requirements.

	• Perform simple techno-economical assessments of solar energy applications. • Understanding the policies related to Indian government initiatives to promote solar energy.

14.	**Course contents***(about 100 words) (include laboratory/design activities)*: Unit I - Solar Energy—Basic Concepts (8) The sun as source of energy - sun, earth radiation spectrum- measurement of solar radiation - solar time - solar radiation geometry - solar day length - empirical equations for estimating terrestrial solar radiation on horizontal surface - solar radiation on inclined plane surface. Unit II - Solar Thermal Collectors (9) Solar collectors – liquid flat plate collector - flat plate air heating collector - evacuated tube collector - thermal analysis of liquid flat plate and evacuated tube collector – solar PVT collectors - compound parabolic concentrator - cylindrical parabolic concentrator - linear fresnel lens collector - paraboloidal dish collector - central tower receiver. Unit III - Solar Thermal Applications (9) Solar water heater – Solar air heater - solar passive space heating and cooling systems - solar cooker - solar dryer - solar distillation – solar pond – solar refrigeration and air conditioning system- solar thermal power plant - solar industrial process heating systems. Unit IV - Solar Photovoltaic energy conversion (10) Solar cell fundamentals - solar cell characteristics –various generations of solar cell- classification – Si wafer-based pv technology - thin film amorphous si technologies - thin film crystalline si cell technologies - dye-sensitized solar cell technology - organic solar cell technology - quantum dot solar cell technology-Perovskite solar cells – Solar PV applications. Unit V - Solar energy: Indian markets, economics and policies (9) Current status of solar energy technologies and markets - The economics of solar energy - Barriers to the development and deployment of solar energy technologies - Government initiatives to promote solar energy - Major achievements in solar sector- Future prospects for solar energy.

15. **Lecture outline***(with topics and number of lectures)*

Module No.	Topics	No. of hours
	Unit-1	8
	The sun as source of energy - sun, earth radiation spectrum- measurement of solar radiation - solar time - solar radiation geometry - solar day length - empirical equations for estimating terrestrial solar radiation on horizontal surface - solar radiation on inclined plane surface	

	Unit – 2	9
	Solar collectors – liquid flat plate collector - flat plate air heating collector - evacuated tube collector - thermal analysis of liquid flat plate and evacuated tube collector compound parabolic concentrator - cylindrical parabolic concentrator - linear fresnel lens collector - paraboloidal dish collector - central tower receiver – PVT collector	
	Unit -3	9
	Solar water heater – Solar air heater - solar passive space heating and cooling systems - solar cooker - solar dryer - solar distillation – solar pond – solar refrigeration and air conditioning system- solar thermal power plant - solar industrial process heating systems	
	Unit – 4	10
	Solar cell fundamentals - solar cell characteristics –various generations of solar cell- classification – Si wafer-based pv technology - thin film amorphous si technologies - thin film crystalline si cell technologies - dye-sensitized solar cell technology - organic solar cell technology - quantum dot solar cell technology-Perovskite solar cells – Solar PV applications	
	Unit – 5	9
	Current status of solar energy technologies and markets - The economics of solar energy - Barriers to the development and deployment of solar energy technologies - Government initiatives to promote solar energy - Major achievements in solar sector- Future prospects for solar energy	
COURSE TOTAL		45

16. Brief description of tutorial activities

Numerical problems will be taught and practiced in the tutorial classes

17. Brief description of laboratory activities

Module No.	Experiment description	No. of hours

18. Suggested texts and reference materials

Text Books:

1. Garg H.P., Prakash J., Solar Energy – Fundamentals and Applications, Tata McGraw Hill,

2000.
2. Sukhatme S.P. and Nayak J.K., Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw Hill, 2010.
3. Khan B.H., Non-Conventional Energy Resources, 3rd ed., McGraw Hill, 2017

Reference Books:

1. Napoleon Enteria and Aliakbar Akbarzadeh, Solar Energy Sciences and Engineering Applications, CRC press, 2014.
2. Robert Foster, Majid Ghassemi and Alma Cota, Solar Energy: renewable Energy and the Environment, CRC press, 2010.

Websites

1. https://www.sciencedirect.com/science/article/abs/pii/S1364032111004643

19. Resources required for the course (*itemized and student access requirements, if any*)

19.1.	Software	
19.2.	Hardware	
19.3.	Teaching aides (videos,etc)	
19.4.	Laboratory	
19.5.	Equipment	
19.6.	Classroom infrastructure	**LCD**
19.7.	Site visits	**Nearby Solar Power plants**

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1.	Design-type problems	
20.2.	Open-ended problems	
20.3.	Project-type activity	
20.4.	Open-ended laboratory work	
20.5.	Others : Fundamentals	

Date: **(Signature of the Head of the Department)**

Additive Manufacturing

1.	**Department/Center proposing the course**	Mechanical Engineering
2.	**Course title**	Additive Manufacturing
3.	**L-T-P Structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	ME8TPC18
6.	**Status (Category for program)**	Elective

7.	**Pre-requisites**	Engineering Mechanics, Manufacturing Technology, CAD/CAM, Design of Machine Elements

8.	Status vis-à-vis other courses (Give Course number/title)	
8.1.	Overlap with any UG/PG course of the Dept./Centre	No
8.2.	Overlap with any UG/PG course of other Dept./Centre	No
8.3.	Super cedes any existing course	No

9.	Not allowed for **(indicate program names)**	

10.	Frequency of offering	☐ Every sem	☐ 1st Sem	× 2nd Sem Either Sem

11.	**Faculty who will teach the course**	

12.	**Will the course require any visiting faculty**	

13.	**Course objective***(about 50 words):* • To exploit technology used in additive manufacturing. • To understand importance of additive manufacturing in advance manufacturing process. • To acquire knowledge, techniques and skills to select relevant additive manufacturing process. • To explore the potential of additive manufacturing in different industrial sectors. • To apply 3D printing technology for additive manufacturing.

14. **Course outcome***(about 50 words):*

- Able to define the various process used in Additive Manufacturing
- Able to analyse and select suitable process and materials used in Additive Manufacturing.
- Able to identify, analyse and solve problems related to Additive Manufacturing.
- Able to apply knowledge of additive manufacturing for various real-life applications.
- Able to apply technique of CAD and reverse engineering for geometry transformation in Additive Manufacturing.

15. **Course contents***(about 100 words) (include laboratory/design activities)*:

Unit-1Introduction

Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.

Unit-2Additive Manufacturing Processes

Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).

Unit-3Additive Manufacturing Machines and Systems

Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.

Unit-4Pre-Processing in Additive Manufacturing

Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.

Unit-5Post-Processing in Additive Manufacturing

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of

	additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.

16. **Lecture outline***(with topics and number of lectures)*

Module No.	Topics	No. of hours
1.	**Introduction** Overview, Basic principle need and advantages of additive manufacturing, Procedure of product development in additive manufacturing, Classification of additive manufacturing processes, Materials used in additive manufacturing, Challenges in Additive Manufacturing.	8
2	**Additive Manufacturing Processes** Z-Corporation 3D-printing, Stereolithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive manufacturing (MIGAM).	10
3	**Additive Manufacturing Machines and Systems** Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors. Introduction to NC/CNC/DNC machine tools, CNC programming and introduction, Hardware Interpolators, Software Interpolators, Recent developments of CNC systems for additive manufacturing.	6
4	**Pre-Processing in Additive Manufacturing** Preparation of 3D-CAD model, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and Generation of codes for tool path, Surface preparation of materials.	6
5	**Post-Processing in Additive Manufacturing** Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques, Brief information on characterization techniques used in additive manufacturing, Applications of additive manufacturing in rapid prototyping, rapid manufacturing, rapid tooling, repairing and coating.	10
COURSE TOTAL		40

17. Brief description of tutorial activities

The tutorial problems are associated with individual units.

18. Brief description of laboratory activities

Module No.	Experiment description	No. of hours

19. Suggested texts and reference materials

1. Gibson, I, Rosen, D W., and Stucker,B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing,Springer, 2010
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010
3. Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping, World Scientific Publishers, 2014
4. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

20. Resources required for the course (*itemized and student access requirements, if any*)

20.1.	Software	
20.2.	Hardware	
20.3.	Teaching aides (videos,etc)	**Req**
20.4.	Laboratory	
20.5.	Equipment	
20.6.	Classroom infrastructure	**Req**
20.7.	Site visits	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1.	Design-type problems	
21.2.	Open-ended problems	
21.3.	Project-type activity	
21.4.	Open-ended laboratory work	
21.5.	Others (please specify)	

Course Template

1.	**Department/Center proposing the course**	Mechanical Engineering
2.	**Course title**	Soft Computing
3.	**L-T-P Structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	ME08TOE52
6.	**Status (Category for program)**	Open elective 5

7.	**Pre-requisites**	

8.	Status vis-à-vis other courses (Give Course number/title)	
8.1.	Overlap with any UG/PG course of the Dept./Centre	No
8.2.	Overlap with any UG/PG course of other Dept./Centre	No
8.3.	Super cedes any existing course	No

9.	Not allowed for **(indicate program names)**	

10.	Frequency of offering	☐ Every sem ☐ 1st Sem ☐ Sem	8 th Sem Either

11.	**Faculty who will teach the course**	

12.	**Will the course require any visiting faculty**	

13.	**Course objective** *(about 50 words):* CO 1 Understand the fuzzy logic and the concept of fuzziness in various systems and fuzzy set theory. CO 2 Know the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic CO 3 Define through genetic algorithms and other random search measures suitable while seeking global optimum in self learning circumstances. CO 4 Recognize suitable learning rules for individual of the architectures and acquire numerous neural network models and its applications. CO 5 Develop some understanding with recent research problems and research methods in Soft Computing Techniques.

14.	**Course outcome** *(about 50 words):* • Graduates will gain a strong foundation in Soft Computing both in theoretical & applied concepts. • Obtain knowledge and hands-on capability in the fuzzy logic and the concept of fuzziness • Graduates will be able to solve application based recent research problems and research methods in Soft Computing Techniques.

15	• **Unit I** Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.
	• **Unit II** FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.
	• **Unit III** NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation
	• **Unit IV** GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method.
	• **Unit V** APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm-based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.

16. Lecture outline *(with topics and number of lectures)*

Module No.	Topics	No. of hours
1	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	08
2	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	08
3	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering	08

	algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	
4	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method.	08
5	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	08

17. Brief description of tutorial activities

The tutorial problems are associated with individual units.

18. Brief description of laboratory activities

Module No.	Experiment description	No. of hours

19. Suggested texts and reference materials

Text books:

1. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2.Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3.Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4.Neural Networks and Learning Machines Simon Haykin (PHI)
5.Sivanandam, Deepa, “Principles of Soft Computing”, Wiley
6.Jang J.S.R, Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall
7.Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill
8.Laurene Fausett, "Fundamentals of Neural Networks", Prentice Hall
9.D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley
10.Wang, “Fuzzy Logic”, Springer

20. Resources required for the course (*itemized and student access requirements, if any*)

a.	Software	
b.	Hardware	
c.	Teaching aides (videos,etc)	**Req**
d.	Laboratory	
e.	Equipment	

Course Template

1.	**Department/Center proposing the course**	Mechanical Engineering
2.	**Course title**	Management Information System
3.	**L-T-P Structure**	3-0-0
4.	**Credits**	3
5.	**Course number**	ME08THS42
6.	**Status (Category for program)**	Elective from Humanity Science HS-04

7.	**Pre-requisites**	Project Management

8.	Status vis-à-vis other courses (Give Course number/title)	
8.1.	Overlap with any UG/PG course of the Dept./Centre	No
8.2.	Overlap with any UG/PG course of other Dept./Centre	No
8.3.	Super cedes any existing course	No

9.	Not allowed for **(indicate program names)**	

10.	Frequency of offering	☐ Every sem	☐ 1st Sem	☐ 2nd Sem	Either Sem

11.	**Faculty who will teach the course**	

12.	**Will the course require any visiting faculty**	

13.	**Course objective***(about 50 words):* • Analyze systems development and project management methodologies. • Combine analytical thinking, creativity and business-problem-solving as applied to ongoing MIS challenges, future trends, and relevant case studies. • Express ethical awareness and moral reasoning applied to a MIS problem, issue or case study. Analyze systems development and project management methodologies. • Combine analytical thinking, creativity and business-problem-solving as applied to ongoing MIS challenges, future trends, and relevant case studies. • Express ethical awareness and moral reasoning applied to a MIS problem, issue or case study.

14.	**Course outcome***(about 50 words):* • **Critical Thinking:** Students will be required to evaluate techniques and processes to think differently and to solve and resolve problems by using technology, making informed decisions. • **Communication:** Through written and oral analyses of cases, students will further strengthen and enhance their skills in effective communication. All assignments and presentations will be prepared in professional language and format. • **Team Work:** Students will work collaboratively, demonstrating courtesy, using appropriate etiquette, in preparing and presenting presentations. • **Problem Solving:** Students will be required to not only identify problems but also generate solutions and make recommendations based on a logical and thorough analysis of the alternatives.

15.	**Course contents***(about 100 words) (include laboratory/design activities)*: • **Unit-1**, **Information for Decision Making:** Decision Making, Conceptual Foundations of Information Systems, Information Resources Management • **Unit-2**, **System Development:** Overview of Systems Analysis & Design, System Development Life Cycle, Designing On Line & Distributed Environments-Design Consideration, Implementation and Control of Projects • **Unit-3**, **Computer Networks & Data Communications:** Trends in Information Technology-Hardware, Software, Data Communication Concepts, Computer Networks • **Unit-4**: **Managing Corporate Data Resources:** Organizing Data, Relational Data Base Management Systems, Query Languages Including DSS, Applications and Illustrations • **Unit-5**: **Socio-Legal Aspects Of Computerization:** Social Dimensions of Computerization, Computer Viruses, Legal Dimensions of Computerization

16. **Lecture outline***(with topics and number of lectures)*

Module No.	Topics	No. of hours
1.	Definition of MIS- Data Processing , Decision Support Systems – Information Resources Management	4
2.	Decision Making Process – Problem Formulation - Programmed Vs Non Programmed Decision – Criteria for Decision Making	4
2	Classical Economical Model – Administrative Model – Resolution of Conflict – Uncertainty Avoidance – Problematic Search – Incremental Decision Making	4

3	Definition of Information – Redundancy – Sending and Receiving efficiency – utility of information – Errors and Bias -Value of Information and Sensitivity Analysis - Information system design.	4
4	Types of system – Subsystem- Preventing System entropy – System Stress – Organizational efficiency and effectiveness	4
5	Use of subsystems in information System Design – Decoupling of information systems – Project Management.	4
6	Logical Data Concepts , Sequencing of Data , Types of Files , Data Bases .Serial Access and Direct Access devices.	4
7	Sequential, Hashed and indexed File Organization – Data Base Organization – single flat File – Hierarchical , Network, Relational DB Structures. Transaction Processing – Control and Retrieval .	4
8	Social Dimensions of Computerization, Computer Viruses, Legal Dimensions of Computerization	4
9	Word and Text Processing . Document Filing Computer Graphics , Composition and Reproduction.	4
10	Document Distribution, Facsimile Transmission, Message Systems, Information Processing Control- Availability Controls.	4
COURSE TOTAL		40

17. Brief description of tutorial activities

The tutorial problems are associated with individual units.

18. Brief description of laboratory activities

Module No.	Experiment description	No. of hours

19. Suggested texts and reference materials

1. Kenneth C. Laudon,Management information systems: managing the digital firm.
2. Effy Oz, Management information systems, Course Technology India.
3. S. Sadagopan, Management information systems , PHI Learning Pvt. Ltd. 1998 Edition, PHI ISBN 81-20311809.
4. Gordon B. Davis And Maggrethe H . Olson , Management Information Systems , Mc Graw Hill International Edition - Second Edition , 1998.
5. Rober G . Mudrick , Joel E . Ross And James R . ClAGGET , Information Systems For Modern Management , 33rd Edition , 1992 , Prentice Hall Of India (P) Ltd ., Eastern Economy Edition.
6. Jerome Kanter Management Information Systems, 3rd Edition , 1990 . Prentice Hall Of India Ltd. , Eastern Economy Edition.
7. Murdick. G.R., Information systems for modern management", 2nd Edition. PHI.
8. Management Information systems- managing information technology in the internet worked enterprise- jams. A OBrien – Tata McGraw Hill publishing company limited, 2002.
9. Laaudon and Laudon, Management Information Systems", PHI ISBN 81-203-1282-1.1998.

20. Resources required for the course (*itemized and student access requirements, if any*)

20.1.	Software	
20.2.	Hardware	
20.3.	Teaching aides (videos,etc)	**Req**
20.4.	Laboratory	
20.5.	Equipment	
20.6.	Classroom infrastructure	**Req**
20.7.	Site visits	

21. Design content of the course (*Percent of student time with examples, if possible*)

21.1.	Design-type problems	
21.2.	Open-ended problems	
21.3.	Project-type activity	
21.4.	Open-ended laboratory work	
21.5.	Others (please specify)	

Date: **(Signature of the Head of the Department)**

Subject: **Design of Thermal Systems (MEPATP4)**

		Credits			
		L	T	P	Total
Type:	Programme Elective				
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course outcomes: **At the end of the course, students will be able to**

1 Understand engineering design for thermal systems

2 Formulate design problem for a given thermal system

3 Prepare mathematical model of a thermal system

4 Apply numerical modelling techniques for thermal systems

5 Apply design considerations for different applications and evaluate economic considerations

Syllabus Contents:

Module-I: Introduction – Engineering design, Design as part of Engineering Enterprises, Thermal systems

Module-II: Basic considerations in Design – Formulation of the design problem, Conceptual design, Steps in the design process, Computer aided design of thermal systems, Materials selection

Module-III: Modelling of Thermal Systems – Introduction, Types of models, Mathematical modelling, Physical modelling, and dimensional analysis, curve fitting

Module-IV: Numerical Modelling and Simulation – Numerical modelling, Solution procedures, Numerical model for a system, System simulation, Methods for numerical simulation

Module-V: Design of Thermal Systems – Introduction, Design strategies, Design of system from different application areas, Additional considerations for large practical systems, Economic considerations.

References:

- Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, CRC Press 2008
- W.F. Stoecker, Design of Thermal Systems, 3rd Edition, McGraw Hill
- William S. Janna, Design of Fluid Thermal Systems, 4th Edition, Cengage Learning

Subject: **Research Methodology & IPR (IPPATC1)**

		Credits			
		L	T	P	Total
Type:	MANDATORY COURSE				
Teaching Scheme:	Lectures: 3 hours/week	1	0	2	2

Course outcomes: **At the end of the course, students will be able to**

1. Understand research problem formulation
2. Analyze research related information
3. Follow research ethics
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property
5. Right to be promoted among students in general & engineering in particular

Syllabus Contents:

Module-1: Introduction and Design of research: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.

Module-II: Data and Methods of Data Collection: Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

Module-III: Data Analysis: Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two way, chi square test and its application, students 'T' distribution, non-parametric statistical techniques, binomial test. Correlation and regression analysis – discriminate analysis – factor analysis – cluster analysis, measures of relationship

Module-IV: Research report preparation and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.

Module-V: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT

References:

- Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon
- Research Methodology – Methods and Techniques, C K Kothari, New Age International
- Design and Analysis of Experiments, D C Montgomery, Wiley
- Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley
- Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education

Subject: **Noise, Vibration & Harshness (MEPBTP5)**

		Credits			
		L	T	P	Total
Type:	Programme Elective				
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course outcomes: **At the end of the course, students will be able to**

1 Identify sources of noise and vibration

2 Measure sound intensity and human sensitivity

3 Model statistical energy analysis and simulators

4 Evaluate active control techniques

5 Identify and evaluate the signal processing techniques

Syllabus Contents:

Module-I: NVH in the Automotive Industry :Sources of noise and vibration. Design features. Common problems. Marque values. Noise quality. Pass-by noise requirements. Target vehicles and objective targets. Development stages in a new vehicle programme and the altering role of NVH engineers.

Module-II: Sound and Vibration Theory :Sound measurement. Human sensitivity and weighting factors. Combining sound sources. Acoustical resonances. Properties of acoustic materials. Transient and steady state response of one degree of freedom system applied to vehicle systems. Transmissibility. Modes of vibration.

Module-III: Test Facilities and Instrumentation :Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings., Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis.

Module-IV: Signal Processing: Sampling, aliasing and resolution. Statistical analysis. Frequency analysis. Campbell's plots, cascade diagrams, coherence and correlation functions.

Module-V: NVH Control Strategies & Comfort: Source ranking. Noise path analysis. Modal analysis. Design of Experiments, Optimization of dynamic characteristics. Vibration absorbers and Helmholtz resonators. Active control techniques.

References:

- Norton M P, Fundamental of Noise and Vibration, Cambridge University Press,2001
- Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 2002
- Baxa, Noise Control of Internal Combustion Engine, John Wiley, 2000
- Ewins D. J., Model Testing : Theory and Practice, John Wiley,1995
- Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993
- McConnell K, “Vibration Testing Theory and Practice”, John Wiley, 1995

Subject: **Computational Fluid Dynamics (MEPBTP6)**

		Credits			
Type:	Programme Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course outcomes: **At the end of the course, students will be able to**

1 Develop the governing equations and understand the behavior of the equations

2 Understand the stepwise procedure to completely solve a fluid dynamics problem using computational methods

3 Analyse the consistency, stability and convergence of discretization schemes for parabolic, elliptic and hyperbolic partial differential equations

4 Analyse variations of SIMPLE schemes for incompressible flows and variations of Flux Splitting algorithms for compressible flows

5 Evaluate methods of grid generation techniques and application of finite difference and finite volume methods to thermal problems

Syllabus Contents:

Module-I: Introduction: History and Philosophy of computational fluid dynamics, CFD as a design and research tool, Applications of CFD in engineering, Programming fundamentals, MATLAB programming, Numerical Methods; Governing equations of fluid dynamics: Models of the flow, the substantial derivative, Physical meaning of the divergence of velocity, Navier-Stokes equations for viscous flow, Euler equations for inviscid flow, Physical boundary conditions, Forms of the governing equations suited for CFD, Conservation form of the equations, Time marching and space marching.

Module-II: Mathematicalbehavior of partial differential equations: Classification of quasi-linear partial differential equations, Methods of determining the classification, General behavior of Hyperbolic, Parabolic and Elliptic equations.Basic aspects of discretization: Introduction to finite differences, Finite difference equations using Taylor series expansion and polynomials, Explicit and implicit approaches, Uniform and unequally spaced grid points.

Module-III: Parabolic partial differential equations: Finite difference formulations, Explicit methods – FTCS, Richardson and DuFort-Frankel methods, Implicit methods – Laasonen, Crank-Nicolson and Beta formulation methods, Approximate factorization, Fractional step methods, Consistency analysis, Linearization.Stability analysis: Discrete Perturbation Stability analysis, von Neumann Stability analysis, Error analysis, Modified equations, Artificial dissipation and dispersion.

Module-IV: Elliptic equations: Finite difference formulation, solution algorithms: Jacobi- iteration method, Gauss-Siedel iteration method, point- and line-successive over-relaxation methods, alternative direction implicit methods.Hyperbolic equations: Explicit and implicit finite difference formulations, Scalar representation of Navier-Stokes equations: Equations of fluid motion, numerical algorithms: ftcs explicit, ftbcs explicit, Dufort-Frankel explicit, Maccormack explicit and implicit, btcs and btbcs implicit algorithms, applications.

Module-V: Grids with appropriate transformation: General transformation of the equations, Metrics and Jacobians, The transformed governing equations of the CFD, Boundary fitted coordinate systems, Algebraic and elliptic grid generation techniques, Adaptive grids.GRID GENERATION: Algebraic Grid Generation, Elliptic Grid Generation, Hyperbolic Grid Generation, Parabolic Grid Generation.Finite volume method for unstructured grids: Advantages, Cell Centered and Nodal point Approaches, Solution of Generic Equation with tetra hedral Elements, 2-D Heat conduction with Triangular Elements.

References:

- Anderson, J.D.(Jr), Computational Fluid Dynamics, McGraw-Hill Book Company, 1995
- Hoffman, K.A., and Chiang, S.T., Computational Fluid Dynamics, Vol. I, II and III, Engineering Education System, Kansas, USA, 2000
- Chung, T.J., Computational Fluid Dynamics, Cambridge University Press, 2003