BANGALORE UNIVERSITY

Scheme of Study for
III Semester to VIII Semester B. Tech. Programme
in
MECHANICAL ENGINEERING
Under CBCS scheme As per NEP 2021

DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING
Bangalore University
K. R. Circle, Bengaluru – 560 001

Date: 21.11.2022

Department of Mechanical Engineering, UVCE, Bengaluru

Proceedings of the meeting of the Board of Studies in Mechanical Engineering held on 21.11.2022 in the Department of Mechanical Engineering, UVCE, Bengaluru

Members Present

1. Dr. C. K. Umesh, Professor & Chairman, UVCE, Bangalore.
2. Dr. S. Paul Vizhian, Professor, UVCE, Bangalore.
3. Dr. B. M. Rajaprakash, Professor, UVCE, Bangalore.
4. Dr. Shivarudraiah, Professor, UVCE, Bangalore.
5. Dr. U. N. Kempaiah, Professor, UVCE, Bangalore.
6. Dr. H. C. Chittappa, Professor, UVCE, Bangalore.
7. Dr. H. K. Shivananad, Professor, UVCE, Bangalore.
8. Dr. Chandrashekar Bendigeri, UVCE, Bangalore.
9. Dr. H. N. Vidyasagar, Professor, UVCE, Bangalore.
10. Dr. D. K. Ramesh, Professor, UVCE, Bangalore.
11. Dr. Channabasappa Hamapli, Professor, REVA University, Bengaluru.
12. Dr. Nanjundaradhya, Professor, RVCE, Bengaluru.
13. Dr. Madhu D., Professor, Government Engineering College, Ramanagara.

Members Absent

1. Dr. N Lakshmanswamy, Professor, UVCE, Bangalore.
2. Dr. Ganga Reddy, General Manager, Head of Aerospace and Defence Mechanical Division, HCL Technologies, Bangalore.

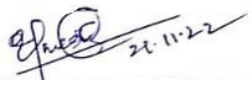
The Chairman welcomed all the BOS members to the meeting and explained the following agenda:

1. The 3rd and 8th Semester Scheme and Syllabus of NEP (CBCS)-2021 for B. Tech Programme was placed before the BOS members.

The BOS members after detailed discussion approved the following agenda item and gave the suggestion and valuable feed back and same are incorporated.

1. The BOS discussed the Scheme and Syllabus for 3rd and 8th Semester NEP (CBCS)-2021 for B. Tech. Programmes with small corrections and approved the same.

The BOS also authorized the BOS Chairman to make any correction in the Scheme and Syllabus. Finally, the Chairman thanked the members for their kind support and the involvement in smooth conduct of the meeting.



CHAIRMAN

Members present for BOS meeting held on 21.11.2022 at 11.00AM in the Department of Mechanical engineering, UVCE, Bangalore.

Sl. NO.	Names oltfle B.OS. Members	Signature
1.	Dr. C K Umesh, Professor & Chairman Department gf Mechanical Engineering, UVCE, Bangal ore.	21.11.22
2.	D r. S. Paul Vizhian, Pror ssor . Department or Mechanical Engineering, 8VfE, Bangalore.	21/11/22
Z.	DP. Hi Lafihmansivamy. Professor . Department or mechanical Engineering, UVCE. Bangalore.	— ABSENT —
4.	Dr. B. M. Rajaprakash. Prom t« , Depa›tmenf of /vlechanical Engineering UVCE. Bangalore.	21.11.2022
5.	Dr. Shivarudraiah. Professor , Department r Mechani'..'I Engineering, UVCE, Bangalore.	21/11/2022
6.	Dr. U. N. Kempaiah, Professor , Depamnenr of f•1echar›ical Engineering, UVCE, Bangalore.	21/11/22
7.	Dr. H. C. Chittappa. Professor Department of Mechanical Engineering, UVCE, Bangalore.	21/11/22
8.	Dr. I-t. IC Shivananad,. Professor , Department of Mechanical Engineenng. UVCE, Bangalore	21/11/22
9.	Dr. Chandrashekar Bendig i, p«ressof DepartTTjenr or Mechanical Engineering, tfVC5, Bangalore.	
10.	Dr. H N Vidyasagar, Professor Department of Mechanical Engineering, UVCE, Bangalore.	21/11/22
11.	Dr. D K Ramesh. Professor Department of Mechanical Engineering UvCE, Bangalore.	21/11/22
12	Dr. Channabasappa Ham i. Professor, Department of Mechanical Engineering. Reva University, Itukmini knowledge Park KattigenahalTt. YeJahanka, Benealuru- 560064.	21.11.2022
13	gr. Nanjundaradhya, Professor , Department of Mechanical Engineering, RVCE. Mysore Rd. RY VidyanikeLan, P0st, Bengalur u-5600 59.	21/11/2022
11	Dr. Madhu D, Professor. Departme nt of I\Mechanical Engineering. Gow Engg College, Doddamannina Gudde, Near Janapadalokn, B.M. Road, Ramanagara, -S62IS9.	21/11/2022
15	Dr. Ganga Reddy, General Manager, Head of *ifierospace* and defence NechaniaJ *Division,* HCL Technologies, Bangalore-S60J00.	— ABSENT —

CHAIRMAN PERSON
Department Council
Department of Mechanical EnSinccring
University Visvesvaraya College of Engineering
K.R. Circle, B

BANGALORE UNIVERSITY

VISION:

"To strive for excellence in education for the realization of a vibrant and inclusive society through knowledge creation and dissemination"

MISSION:

- Impart quality education to meet national and global challenges.
- Blend theoretical knowledge with practical skills.
- Pursue academic excellence through high quality research and publications.
- Provide access to all sections of society to pursue higher education.
- Inculcate right values among students while encouraging competitiveness to promote leadership qualities.
- Produce socially sensitive citizens.
- Hasten the process of creating a knowledge society.
- To contribute to nation building.

BANGALORE UNIVERSITY

UNIVERSITY VISVESVARAYA COLLEGE OF ENGINEERING
K. R. Circle, Bengaluru-560 001.

University Visvesvaraya College of Engineering (UVCE) was started as a School of Mechanical Engineering by **Bharat Ratna Sir. M. Visvesvaraya** in the year 1913 to meet the needs of the State for skilled workers with **S. V. Setty as its Superintendent**. Later, it was converted to a full-fledged Engineering College in the year 1917 under the name Government Engineering College and was affiliated to the University of Mysore. It is the fifth Engineering College to be established in the country.

After the formation of Bangalore University in 1964, UVCE became one of the Constituent Colleges of Bangalore University. This is one of the oldest Institutions in the country imparting technical education leading to BE, ME, B. Arch, M.Sc. (Engineering), M. Arch.and Ph.D. degrees in various disciplines of Engineering and Architecture. The Institution currently offers 7 Undergraduate (B. Tech/B. Arch.) Full-time, three Undergraduate (B.E.) Part-time and 24 Postgraduate (M. Tech/M. Arch) Programmers.

VISION

The vision of UVCE is to strive for excellence in advancing engineering education through path breaking innovations across the frontiers of human knowledge to realize a vibrant, inclusive and humane society.

MISSION

The mission of UVCE is to prepare human resource and global leaders to achieve the above vision through discovery, invention and develop friendly technologies to promote scientific temper for a healthy society. UVCE shapes engineers to respond competently and confidently to the economic, social and organizational challenges arising from globally advancing technical needs.

Bangalore University

University Visvesvaraya College of Engineering, Bangalore

MECHANICAL ENGINEERING

Tentative Scheme of Teaching and Examination for **III Semester B.Tech.** under CBCS scheme As per NEP 2021

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week				Total hr/ week	Examination				Credits
					L	T	P	SS		Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	BS	21BSEM301	Engineering Mathematics –III	Mathematics	2	2	0	0	4	3	50	50	100	3
2	PC	21MEPC302	Mechanics of Materials	MECH	2	2	0	0	4	3	50	50	100	3
3	PC	21MEPC303	Material Science and Metallurgy	MECH	2	2	0	0	4	3	50	50	100	3
4	PC	21MEPC304	Fundamentals of Thermodynamics	MECH	2	2	0	0	4	3	50	50	100	3
5	PC	21MEPC305L	Machine Drawing - I	MECH	0	0	3	0	3	3	50	50	100	1
6	PC	21MEPC306L	Work shop -II	MECH	0	0	3	0	3	3	50	50	100	1
7	PC	21MEPC307L	Material Testing Laboratory	MECH	0	0	3	0	3	3	50	50	100	1
8	HS	21KAHS308A	Mandatory Courses (Government of Karnataka) / Samskrutika Kannada	Kannada	0	2	0	0	2	2	50	50	100	1
		OR												
		21KAHS308B	Mandatory Courses (Government of Karnataka) / Balake Kannada	Kannada	0	2	0	0	2	2				
9	IN	21MEIN309	Summer Internship – I	TPO/MECH	--	--	6	--	--	--	50	50	100	2
10	AE	21MEAE310L	Ability Enhance course Computer aided Drafting/Modeling	MECH	0	0	3	0	3	3	50	50	100	1
11	HV	21UHV311	Universal Human Values-I	MECH	1	0	0	0	1	2	50	50	100	1
Total					--	--	--	--	--		**550**	**550**	**1100**	**20**

12	BS	21BSBM312	Bridge Mathematics-I (Lateral Entry students)	Maths	2	2	--	--	4	3	50	50	100	3

***SEE Shall be conducted for 100 Marks obtained shall be scaled down to 50 marks.**

Note: Internship to commence from vacation after II Sem B Tech and to be evaluated in III Sem B.Tech

Note: BS: Basic Science Course, PC: Professional Core Course, HS: Humanity and Social Science & Management Courses, AE: Ability Enhancement Courses. IN: Internship, HV: Universal Human Value Courses

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

Bangalore University

University Visvesvaraya College of Engineering, Bangalore

MECHANICAL ENGINEERING

Tentative Scheme of Teaching and Examination for **IV Semester B.Tech.** under CBCS scheme As per NEP 2021

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week				Total hr/ week	Examination				Credits
					L	T	P	SS		Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	BS	21BSEM401	Engineering Mathematics –IV	Mathematics	2	2	0	0	4	3	50	50	100	3
2	PC	21MEPC402	Kinematics of Machines	MECH	2	2	0	0	4	3	50	50	100	3
3	PC	21MEPC403	Manufacturing Process –I	MECH	2	2	0	0	4	3	50	50	100	3
4	PC	21MEPC404	Applied Thermodynamics	MECH	2	2	0	0	4	3	50	50	100	3
5	PC	21MEPC405L	Machine Drawing - II	MECH	0	0	3	0	3	3	50	50	100	1
6	PC	21MEPC406L	Machine Shop - I	MECH	0	0	3	0	3	3	50	50	100	1
7	PC	21MEPC407L	Energy Laboratory	MECH	0	0	3	0	3	3	50	50	100	1
8	HS	21HSCP408	Constitution of India, Professional Ethics	LAW	0	2	0	0	2	2	50	50	100	1
9	AE	21AE409	Ability enhancement course – Biology for Engineering	BIOLOGY	2	0	0	0	2	2	50	50	100	2
10	AE	21ME410	Ability Enhance course GD & NT	MECH	0	2	0	0	2	2	50	50	100	1
11	HV	21HV411	Universal Human Values -II	MECH	1	0	0	0	1	2	50	50	100	1
Total					**--**	**--**	**--**	**--**	**--**		**550**	**550**	**1100**	**20**

12	BS	21BSBM412	Bridge Mathematics-II (Lateral Entry students)	Maths	2	2	--	--	4	3	50	50	100	3

***SEE Shall be conducted for 100 Marks obtained shall be scaled down to 50 marks.**

Note: BS: Basic Science Course, PC: Professional Core Course, HS: Humanity and Social Science & Management Courses, AE: Ability Enhancement Courses. IN: Internship, HV: Universal Human Value Courses

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Bangalore University

University Visvesvaraya College of Engineering, Bangalore

MECHANICAL ENGINEERING

Tentative Scheme of Teaching and Examination for **V Semester B.Tech.** under CBCS scheme As per NEP 2021

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week				Total hr/ week	Examination				Credits
					L	T	P	SS		Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	PC	21MEPC501	Machine Design –I	MECH	2	2	0	0	4	3	50	50	100	3
2	PC	21MEPC502	Manufacturing Process –II	MECH	2	2	0	0	4	3	50	50	100	3
3	PC	21MEPC503	Fluid Mechanics and Machinery	MECH	2	2	0	0	4	3	50	50	100	3
4	PC	21MEPC504	Dynamics of Machines	MECH	2	2	0	0	4	3	50	50	100	3
5	PC	21MEPC505L	Manufacturing Laboratory	MECH	0	0	3	0	3	3	50	50	100	1
6	PC	21MEPC506L	Fluid Mechanics Laboratory	MECH	0	0	3	0	3	3	50	50	100	1
7	AE	21MEAE507L	Engineering Analysis using – MAT Lab	MECH	0	2	3	0	5	3	50	50	100	2
8	HS	21CVHS508	Environmental Science	Civil Board	0	2	0	0	2	3	50	50	100	1
9	IN	21MEIN509	Summer Internship - II	TPO/ MECH	--	2	6	--	--	2	50	50	100	3
Total					--			--	--	--	**450**	**450**	**900**	**20**

***SEE Shall be conducted for 100 Marks obtained shall be scaled down to 50 marks.**

Note: Internship to commence from vacation after IV Sem B Tech for a duration of 4 to 8 weeks and to be evaluated in V Sem B.Tech

Note: BS: Basic Science Course, PC: Professional Core Course, HS: Humanity and Social Science & Management Courses, AE: Ability Enhancement Courses. IN: Internship, HV: Universal Human Value Courses

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University Visvesvaraya College of Engineering, Bangalore

MECHANICAL ENGINEERING

Tentative Scheme of Teaching and Examination for **VI Semester B.Tech.** under CBCS scheme As per NEP 2021

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week				Total hr/ week	Examination				Credits
					L	T	P	SS		Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	PC	21MEPC601	Mechanical Measurements and Metrology	MECH	2	2	0	0	4	3	50	50	100	3
2	PC	21MEPC602	Machine Design -II	MECH	2	2	0	0	4	3	50	50	100	3
3	PC	21MEPC603	Finite Element Methods	MECH	2	2	0	0	4	3	50	50	100	3
4	PE	21MEPE604*	Professional Elective-I	MECH	2	2	0	0	4	3	50	50	100	3
5	OE	21MEOE605*	Open Elective - I	MECH	2	2	0	0	4	3	50	50	100	3
6	PC	21MEPC606L	Measurements and Metrology Lab	MECH	0	0	3	0	3	3	50	50	100	1
7	PC	21MEPC607L	Design Lab	MECH	0	0	3	0	3	3	50	50	100	1
8	MP	21MEMP608	Mini Project	MECH	--	--	3	4	7	2	50	50	100	2
9	AE	21MEAE609	CAD/CAM Robotics Lab	MECH	0	0	3	0	3	3	50	50	100	1
10	IN	21MEIN610	Placement Internship-III	TPO/MECH	--	--	--	--	--	-	--	--	--	--
Total					**--**			**--**	**--**	**--**	**450**	**450**	**900**	**20**

***SEE Shall be conducted for 100 Marks obtained shall be scaled down to 50 marks.**

Note: Placement internship to be carried out in VI sem offered by TPO/MECH, UVCE. on Successful completion students will be awarded 20 activity points.

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Sl No	Course Code	Professional Elective-I
1	21MEPE604A	Control Engineering
2	21MEPE604B	Biomaterials and Technology
3	21MEPE604C	CAD/CAM & Robotics
4	21MEPE604D	Internal Combustion Engines
5	21MEPE604E	Operation Research
6	21MEPE604F	Industrial Management
7	21MEPE604G	Product life cycle and Management
8	21MEPE604H	Non -Traditional Machining Processes

Sl No	Course Code	Open Elective – I
1	21MEOE605A	Industrial Safety
2	21MEOE605B	Fundamentals of Aerospace Engineering
3	21MEOE605C	Engineering Economics

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University Visvesvaraya College of Engineering, Bangalore

MECHANICAL ENGINEERING

Tentative Scheme of Teaching and Examination for **VII / VIII Semester B.Tech** under CBCS scheme As per NEP 2021

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week				Total hr/ week	Examination				Credits
					L	T	P	SS		Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	PC	21MEPC701	Heat Transfer	MECH	2	2	0	0	4	3	50	50	100	3
2	PE	21MEPE702*	Professional Elective-II	MECH	2	2	0	0	4	3	50	50	100	3
3	PE	21MEPE703*	Professional Elective-III	MECH	2	2	0	0	4	3	50	50	100	3
4	OE	21MEOE704*	Open Elective - II		2	2	0	0	4	3	50	50	100	3
5	PW	21MEPW705L	Project work	MECH	--	--	9	28	9	3	50	50	100	10
6	AE	21MEAE706	Automation Laboratory	MECH	0	0	3	0	3	3	50	50	100	2
											300	**300**	**600**	**24**

OR

Tentative Scheme of Teaching and Examination for **VII / VIII Semester B.Tech** under CBCS scheme As per NEP 2020

Sl. No.	Course category	Course Code	Title	Teaching Department	Teaching Hours/week					Examination				Credits
					L	T	P	SS	Total hr/week	Duration (Hrs)	CIE Marks	*SEE Marks	Total Marks	
1	IN	21MEIN801	Research/Industrial Internship	MECH	--	--	--	--	--		100	100	200	15
2	SE	21MESE802	** Technical Seminar / Industrial Visit	MECH	0	2	0	0	2		100	--	100	01
Total					**--**	**--**	**--**	**--**	**--**		**200**	**100**	**300**	**16**

***SEE Shall be conducted for 100 Marks obtained shall be scaled down to 50 marks.**

**** For Industrial Visit or Project Tour detailed report has to be submitted.**

Sl No	Course Code	Professional Elective-II
1	21MEPE702A	Energy Resource & Power Plant Engineering
2	21MEPE702B	Mechatronics
3	21MEPE702C	Automation in Manufacturing
4	21MEPE702D	Production and Operation Management
5	21MEPE702E	Additive Manufacturing
6	21MEPE702F	Modern Methods of Manufacturing
7	21MEPE702G	Automobile Engineering
8	21MEPE702H	Composite Materials Technology

Sl No	Course Code	Professional Elective-III
1	21MEPE703A	Total Quality Management
2	21MEPE703B	Smart Materials and structures
3	21MEPE703C	Industry 4.0
4	21MEPE703D	Refrigeration and Air-conditioning
5	21MEPE703E	Financial Management and Costing

Sl No	Course Code	Open Elective-II
1	21MEOE704A	Fundamentals of Robotics
2	21MEOE704B	Smart Materials

Note: BS: Basic Science Course, PC: Professional Core Course, HS: Humanity and Social Science & Management Courses, AE: Ability Enhancement Courses. IN: Internship, HV: Universal Human Value Courses

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BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP – 2021

<table>
<tr><td>Course Code</td><td colspan="2">21BSEM301</td><td colspan="3">B. Tech (Mechanical Engineering)</td><td colspan="2"></td></tr>
<tr><td>Category</td><td colspan="5">Basic Science Course</td><td colspan="2">Semester: III</td></tr>
<tr><td>Course title</td><td colspan="7">ENGINEERING MATHEMATICS-III</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td><td></td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td colspan="2">Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. Understand the properties of Fourier series.
2. Study the applications of Fourier Transforms and Z-Transforms.
3. Understand what functional are, and have some appreciation of their applications.
4. Introduce students to how to solve linear Partial Differential with different methods.
5. Appreciate the importance of probability and statistics in computing and research.

COURSE CONTENT

Unit-1

Fourier Series: Periodic functions, Fourier expansions, Half range expansions, Complex Fourier Series, Practical harmonic analysis, Applications. **10Hours**

Unit -2

Fourier Transforms: Finite and infinite Fourier Transforms, Fourier sine and cosine Transforms, Properties, Inverse Transforms. Z–Transforms: Definition, Standard Z-Transforms, Linearity property, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-Transforms. Application of Z-Transforms to solve difference equations.

10Hours

Unit-3

Calculus of variations: Variation of a function and a functional. External of a function, variational problems, Euler's equation, standard variational problems including Geodesics, Minimal surface of revolution, hanging chain, Brachistochrone problems.

10Hours

Unit-4

Partial Differential Equations (P.D.E.): Formulation of P.D.E., Solution of non-homogeneous P.D.E. by direct integration, Method of separation of variables (first and second order equations), Solution of Lagrange's linear P.D.E. of the type Pp + Qq = R, solution of standard types of nonlinear P.D.E.- Charpit's method.

10Hours

Unit-5

Statistics and probability: Curve fitting, fitting of a straight line, fitting of a curve of the firmy = ab^x, Fitting of a Parabola. Correlation. Regression. Basic concepts of probability, Addition theorem, Conditional probability, Multiplication theorem, Bayes' theorem. Random variables: Discrete and continuous random variables – PDF, CDF. Binomial, Poisson, Exponential and Normal distributions. Joint Probability: Joint probability distributions, concept of joint probability, joint distributions, discrete and continuous, independent random variables, problems on expectation and variance.

10 Hours

Text Books

1. B. S .Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chandand Sons publishers.
3. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
4. P. V. ONeil, Advanced Engineering Mathematics, Pearson/Thomson.
5. G.B. Thomas and R.L. Finney, Calculus, Addison Wesley, 9thEd.,1998.
6. Walpole and Myers, Probability and Statistics for Engineers and Scientist, 2007.
7. D.S .Chandrashekaraiah, "Engineering Mathematics-III", Prism Books Pvt. Ltd. 7th Ed., 2014.

Reference Books:

1. B.V. Ramana "Higher Engineering Mathematics" Tata Mc Graw-Hill, 2006
2. N. P. Baliand M. Goyal,"A text book of Engineering mathematics", Laxmi publications, latest Edition.
3. H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand publishing, 1st Ed., 2011.

eBooks / Online Resources

1. https://agrimoon.com/engineering-mathematics-3-pdf-book/
2. https://mrcet.com/downloads/digital_notes/ECE/II%20Year/31082020/MATHEMATICS-III.pdf
3. https://www.goodreads.com/book/show/19170703-engineering-mathematics-iii-book-for-civil-branch
4. https://www.pdfdrive.com/engineering-mathematics-iii-e62350356.html

MOOCs

1. https://nptel.ac.in/courses/111105121
2. https://www.my-mooc.com/en/mooc/introduction-engineering-mathematics-utarlingtonx-engr3-0x/
3. https://www.researchgate.net/publication/310798820_MOOCs_in_First_Year_Engineering_Mathematics_Experiences_and_Future_Aims

COURSE OUTCOMES: Students are able to:

CO1: Write given function in terms of sine and cosine terms in Fourier series and also to get knowledge in Fourier transforms.
CO2: Calculate the Laplace transform of standard functions both from the definition and by using tables.
CO3: Describe the Brachistochrone problem mathematically and solve it; solve isoperimetric problems of standard type.
CO4: To be able to solve linear ordinary differential equations, by using elementary methods in the case of constant coefficients.
CO5: Apply method of least squares to find the curve of best fit for the given data.

SCHEME OF EXAMINATION

CIE-50 Marks			
Unit 1, 2 &3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			

- There shall be 10 questions
- Two full questions to be set from each unit with internal choice.
- ✓ Minimum number of sub questions : 2
- ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any Five questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H										H
CO2	H	H										H
CO3	H	H										H
CO4	H	H										H
CO5	H	H										H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC302**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: III**
Course title	**MECHANICS OF MATERIALS**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1 To understand and acquire the concepts of stresses and strains and the relations between them for different types of loads.
2 To acquire the knowledge to construct the bending moment and shear force diagrams for various beams and loads.
3 To Implement and acquire the concept of bending moment carrying capacity of various sections.
4 To adopt, implement and Evaluate the concept of torsion, stiffness of shafts, energy storing capacity.
5 To understand and acquire the knowledge of deflection and buckling behavior of various beam.

COURSE CONTENT

UNIT-1

Simple Stress and Strain: Stress-Strain Relation, Tension, Compression, Shear, Impact and Repeated Loadings, True Stress and Strain, Hooke's Law, Poisson's Ratio, Elastic Constants, Strain Energy, Factor of Safety, Extension/Shortening of a Bar, Various Bars Subjected to Various Loads, Compound Bars. **10 Hours**

UNIT-2

Compound Stresses: Stresses and Strains in Two and Three Dimensional, Principal Planes and Principal Stresses and Strains, Mohr's Circle of Stresses and Strains, Indeterminate Structural Problems, Temperature Stresses. **10Hours**

UNIT-3

Shear Force and Bending Moment: Sign Convention, Shear Force and Bending Moment Diagrams, (SFD and BMD) for Beams Subjected to Various Loads, Cantilever and Simply Supported Beam Subjected to External Moment. **10 Hours**

UNIT-4

Theory of Simple Bending: Assumptions, Relationship between Bending Stresses and Radius of Curvature, Relationship between Moment and Radius of Curvature, Moment Carrying Capacity of a Section, Shearing Stresses in Beams.

Theory of Pure Torsion, Assumptions, Polar Modulus, Power Transmitted, Torsional Rigidity Stiffness of Shafts. **10 Hours**

UNIT- 5

Deflection of Beams: Deflection by Double Integration and Moment Area Methods for Cantilever and Simply Supported Beams, Curved Beams.

Buckling of Columns, Assumptions, Different End Conditions, Critical Load and Effective Length. **10 Hours**

Text Books:

1. S S Bhavikatti: Strength of Materials, Vikas Publishing House Pvt. Ltd. 4th edition 2013.
2. Sadhu Singh: Strength of Materials, Khanna Publishers, 1992.
3. U C Jindal: Strength of Materials : Umesh Publications, 1991.
4. J B K Das and P L Srinivasa Murthy, Mechanics of Materials, Sapna Book House (P) Ltd, 2016.
5. R.K. Bansal ,Strength of Materials: Mechanics of Solids, Lakshmi Publications, 6th Edition 2022.

References Books:

1. J P Den Hartog : Strength of Materials, Dover Publications, INC, New York, 2008.
2. Beer F P, Johnston E R Jr. : Mechanics of Materials, Mc Graw-Hill Book Company, 1985.

eBooks / Online Resources

1. https://engineeringbookspdf.com/mechanics-of-materials-6th-edition-pdf-free-download/4108/
2. https://www.worldcat.org/title/mechanics-of-materials/oclc/1226231263?referer=di&ht=edition
3. https://www.worldcat.org/title/mechanics-of-materials/oclc/1226231263?referer=di&ht=edition
4. https://www.freebookcentre.net/physics-books-download/Mechanics-of-Materials-Online-Book-.html
5. https://www.amazon.in/Mechanics-Materials-Anthony-Bedford-ebook/dp/B0818L2437
6. https://books.google.com/books?id=AOuqC_d7WTkC&printsec=copyright
7. https://www.mheducation.com.sg/ebook-mechanics-of-materials-8e-in-si-units-9789814923163-asia

MOOCs

1. https://www.classcentral.com/course/mechanics-1-5031
2. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
3. https://onlinecourses.nptel.ac.in/noc22_ce54/preview
4. https://www.udemy.com/course/mechanics-of-materials-sgt/
5. https://ocw.mit.edu/courses/3-11-mechanics-of-materials-fall-1999/
6. https://swayam.gov.in/NPTEL
7. https://www.ecourses.ou.edu/cgi-bin/ebook.cgi?topic=me
8. https://www.coursera.org/courses?query=mechanics%20of%20materials

COURSE OUTCOMES: Students are able to:

CO1: Apply the acquired concepts of stresses and strains and the relations between them for determination of failure stress for designing the components.
CO2: Analyze the bending moment and shear force diagrams at various sections of a beam and design the parts based on the critical value.
CO3: Evaluate the bending moment carrying capacity of machine members of various sections.
CO4: Apply the acquired concept of torsion, stiffness of shafts, energy storing capacity for designing the rotating shafts.
CO5: Evaluate the deflection and buckling behavior of various beam for designing the components for safety.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 &5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	M	H								L
CO2	M	M	M	H								L
CO3	M	H	H	H								L
CO4	H	H	H	H								L
CO5	H	H	H	H								L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC303</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">MATERIAL SCIENCE & METALLURGY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1 To acquire Knowledge of the concepts of crystal structure, imperfection of solids.
2 Analyze the theories of diffusion, phase rule and lever rule.
3 Study the iron carbon diagram, T.T.T diagram and phase diagram.
4 Get knowledge of the mechanical properties of materials.
5 Analyze the concepts of solid solution & phase diagrams.

COURSE CONTENT

UNIT–1

STRUCTURE OF CRYSTALLINE SOLIDS:

Fundamental concepts of Unit cell, Space lattice, Bravis Space lattice, Unit cells for cubic structure & HCP, study of stacking of layers of atoms in cubic structure & HCP, calculations of radius, coordination number and atomic packing factor for different cubic structures.

Crystal Structure: Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, Crystal imperfections–point, line, surface and volume imperfections. Atomic Diffusion: Phenomenon, Fick's laws of diffusion (First and Second Law); Factors affecting diffusion. **10 Hours**

UNIT –2

CONCEPTS OF STRESS & STRAIN: Tensile properties, true stress & strain, Hardness, Rockwell, Vickers & Brinell hardness testing. Plastic deformation - Slip & Twinning. Fracture: types, stages in cup & cone fracture, Griffith's criterion.

Failure of Materials Mechanism of fatigue, fatigue properties, S-N Diagram, Fatigue testing. Creep Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness, numerical on diffusion, strain and stress relaxation. Alloys, Steels, Solidification. **10 Hours**

UNIT –3

ENGINEERING MATERIALS:

Ferrous and non-ferrous materials; Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel Copper alloys-brasses and bronzes, Aluminum alloys - Al-Cu, Al-Si, Al-Zn alloys, Titanium alloys.

Composite Materials; Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's, advantages and applications of composites. **10 Hours**

UNIT-4

HEAT TREATMENT: Ferrous and Non-Ferrous Alloys: Heat treating of metals: Time Temperature- Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Recrystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Mar tempering, Austempering, Concept of harden ability, Factors affecting harden ability.

Surface hardening methods: carburizing, cyaniding, nit riding, flame hardening and induction hardening, Age hardening of aluminium-copper alloys and PH steels. Ferrous materials: Properties, Compositions and uses of grey cast iron and steel. **10 Hours**

UNIT –5

SOLID SOLUTIONS AND PHASE DIAGRAM:

Solid solutions - types, rules governing the formation of solids solutions. Phase diagrams - basic terms, phase rule, cooling curves, construction of phase diagrams, interpretation of equilibriums diagrams,

Phase diagrams: types of phase diagrams, lever rule. Iron carbon equilibrium diagram: phases in the Fe–C system, invariant reactions, critical temperatures, microstructure of slowly cooled steels, effect of alloying elements on the Fe-C diagram, ferrite & austenite stabilizers. TTT diagram for hypo & hypereutectoid steels, effect of alloying elements, CCT diagram. **10 Hours**

Text Books

1 "Materials Science & Engineering- An Introduction", William D. Callister Jr. Wiley India Pvt. Ltd. 6th Edition, 2006, New Delhi.
2 "Material Science & Metallurgy", O. P .Khanna, Dhanpat rai publications.

Reference Books

1 "Essentials of Materials For Science And Engineering", Donald R. Askeland, Pradeep P. Phule Thomson-Engineering, 2006.
2 "Foundation of Material Science and Engineering", Smith, 3rd Edition McGraw Hill, 1997.
3 ASM Handbooks, American Society of Metals.

eBooks / Online Resources

1 Bhattacharya, B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
2 Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials Science and Engineering, Indian Institute of Technology Delhi, http://nptel.ac.in/courses/113102080/
3 Subramaniam, A., Structure of Materials, NPTEL Course Material, Department of Material Science and Engineering, Indian Institute of Technology Kanpur, https://nptel.ac.in/courses/113104014/

4 Schuh, C., 3.40J Physical Metallurgy. Fall 2009. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.
5 Ghosh, R.N., Principles of Physical Metallurgy, IIT Kharagpur, http://nptel.ac.in/syllabus/113105024/

MOOCs

1. https://archive.nptel.ac.in/courses/113/104/113104076/
2. https://www.google.co.in/books/edition/Material_Science_and_Metallurgy/au1bG8BA_Z8C?hl=en&gbpv=1&pg=PR7&printsec=frontcover
3. https://www.academia.edu/44556848/metallurgy_and_material_science

COURSE OUTCOMES: Students are able to:

CO1: Understand the mechanical properties of solids under different loading conditions.
CO2: Conceptualize behavior of tensile properties.
CO3: Analyze phase diagrams and C.C.T & T.T.T diagram.
CO4: Understand heat treatment process.
CO5: Explain different types of engineering alloys.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any *Five* full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L									L
CO2	H	H	L									M
CO3	H	M	L									L
CO4	H	H	L									M
CO5	H	H	H									M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC304**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: III**
Course title	**FUNDAMENTALS OF THERMODYNAMICS**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To enrich the knowledge of students in thermodynamics.
2. To Analyse the Temperature and measurements of temperature.
3. To Apply and evaluate the basic concepts of Work and Heat.
4. To Analyse the properties of First and second law of TD associated with the thermodynamic processes.
5. To Understand the basic concepts of Entropy and gas mixtures.

COURSE CONTENT

UNIT –1

Fundamentals: Macroscopic and Microscopic approaches, Thermodynamic system, control volume, properties, state and process, cycles, Thermodynamic Equilibrium, Quasi-static process.

Temperature: Thermal Equilibrium, Zeroth Law, Measurement of Temperature, Reference points, Ideal gas Temperature scale, Celsius Temperature scale and International Practical Temperature scale.

Work & Heat: Exact and inexact differentials, Thermodynamic definition of Work: examples, displacement work, work as a path function, different forms of work transfer, Heat: definition of heat, heat as a path function, Specific heats, and examples of work and heat interactions. 1**0 Hours**

UNIT –2

First Law of Thermodynamics: First law for cyclic and non-cyclic processes, concept of total energy and energy as the property of a system, various modes of energy, internal energy and enthalpy, Steady Flow Energy Equation (SFEE), Examples of steady flow processes, PMM-1, Limitations of the First Law. Closed system for steady flow energy equation, illustration of other form of work such as strain energy, electrical energy, tension energy, potential energy, and kinetic energy. Apply the first law of thermodynamics for turbine, compressor, centrifugal pump, reciprocating pump, steam nozzle, heat exchanger.

10 Hours

UNIT –3

Second Law of Thermodynamics: Definition of direct and reversed heat engine (Refrigerator and heat pump), definition of thermal efficiency and COP, Kelvin-Planck and Clausius statements, Equivalence of Kelvin-Planck and Clausius statements, Reversibility

and Irreversibility, Causes for Irreversibility, Carnot cycle, Absolute Thermodynamic Temperature scale.

Entropy: Clausius inequality, Definition of entropy, entropy as a property, Two reversible adiabatic paths cannot intersect each other, Entropy change in reversible and Irreversible process, Principle of increase of entropy, Illustration of process on T-S diagram, Entropy generation in a closed system and open system, First and Second Laws combined relations.

10 Hours

UNIT –4

Properties of pure substances: P-V, P-V-T surfaces, and P-T diagrams for pure substances, Steam generation -Enthalpy, Entropy and internal energy of steam - steam tables and charts - vapour processes - Determination of dryness fraction, Throttling measurement of dryness fraction, numerical problems**.**

Properties of gas mixtures: Avogadro's law, equation of state of a gases, gas compression, law of corresponding states, other equation of states, properties of gas mixtures-Dalton, law of partial pressure, entropy of gas mixtures. Vander Waal's Equation and its constants in terms of critical properties, reduced pressure of state, compressibility factor and universal and particular gas constants, perfect and semi-perfect gases. For various quasi-static processes:

10 Hours

UNIT –5

Combustion of Fuels Solid fuels, classification, preparation, cleaning, analysis, ranking and properties action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification. Liquid fuel petroleum origin, production, composition, classification. Secondary fuels Gasoline, diesel, kerosene, and lubricating oils. Fractional distillation method and synthetic liquid fuels. Some of the illustration of ASTM standard procedure for testing fuels.

1**0 Hours**

Text Books

1. Basic and Applied Thermodynamics, P. K. Nag, 2nd Edition, Tata McGraw Hill, 2009
2. Engineering Thermodynamics, R. K. Rajput, 4th Edition, Laxmi Publications, 2010

Reference Books

1. Thermodynamics: An Engineering Approach, Yunus A. Cengel and Michael A. Boles, 8th Edition, Tata-McGraw Hill Pub, 2016.
2. Fundamentals of Thermodynamics, Gordon J. Van Wylan& Richard E. Sonntagg, 7th Edition, Wiley Eastern Ltd, 2009.
3. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning publications, 2009

eBooks / Online Resources

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Edition, Phi Learning, 2005
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112108148/
5. http://nptel.ac.in/courses/112105123/

MOOCs

1. https://www.coursera.org/course/introthermodynamics
2. https://www.iitbombayx.in/courses/IITBombayX/ME209xA15/2015_T1/about

COURSE OUTCOMES: Students are able to:

CO1: Apply the energy balance to thermodynamic systems involving heat and work interactions to determine thermodynamic properties.
CO2: Evaluate the performance of energy conversion devices undergoing a thermodynamic process or cycle and entropy of system.
CO3: Analyse a thermodynamic system for combustion of fuel technology& Irreversibility process.
CO4: Estimate the properties of systems employing ideal and real gases as working fluids
CO5: Applications to the combustion of fuels and process of oxidization reaction systems.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L									H
CO2	H	H										H
CO3	H	H										H
CO4	H	M										H
CO5	M	M	L									H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC305L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">MACHINE DRAWING-I</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Understand the basic concepts of drawing, dimensioning and codes.
2. Learn standards, abbreviations and symbols used in drawings.
3. Understand different thread forms, fasteners and riveted joints and their significance in fabrication.
4. Analyze the pictorial view of the machine parts to draw orthographic views with section and without section.
5. Evaluate the proportionate dimensions of parts of simple joints and couplings from given data.

COURSE CONTENT

UNIT –1

Introduction

B.I.S. Codes in Machine Drawing, Dimensioning, surface Texture symbols and machine parts not sectioned materials in section and welding symbols.

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry and Surface finish.

To draw sketches of the following:

1. **Thread forms:** Thread terminology and conventional representation of screw threads: ISO Metric (Internal & External), BSW (Internal and External), Square, Acme and Sellers thread, American Standard thread.
2. **Fasteners:** Hexagonal headed bolt and nut with washer (assembly), Square headed bolt and nut with washer (assembly), use of Stud bolts with nut and lock nut. Flanged nut, Slotted nut, Taper and Split pin for locking, counter sunk head screw, Grub screw, Allen screw.
3. **Keys :** Parallel, Taper, Feather Key, Gib head key and Woodruff key
4. **Riveted joints:** Single and Double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters). **12 Hours**

UNIT 2

Conversion of Views:

Drawing orthographic views with one sectional view from given pictorial view of simple machine parts. **10 Hours**

UNIT 3

Proportionate assembly drawing (Manual Drafting):

Drawing only Front view in section/half section of the assembly of following Joints and Couplings by evaluating the proportionate dimensions in terms of the given diameter/side of the rod. All proportionate dimensions and part list have to be shown.

1. Socket and Spigot Cotter Joint.
2. Strap Joint with Gib and Cotter.
3. Knuckle Joint
4. Solid Muff coupling and
5. Flanged Couplings **10 Hours**

Text Books

1. Machine Drawing: K. R. Gopala Krishna Subash Publications

Reference Books

1 N.D. Bhatt, Machine Drawing, Charotar Publishing house, Anand, New Delhi, 28th edition,
2 N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co. Ltd., 5th edition, 1994
3 K. L. Narayana, P. Kannaiah, K. Venkat Reddy, Machine Drawing, New Age International (P)Ltd., 2nd edition 1999.
4 K. C. John, Text book of Machine Drawing, PHI Learning

eBooks / Online Resources

1. https://easyengineering.net/machine-drawing-by-narayana
2. https://Textbook-Machine-Drawing-R-K-Dhawan-ebook/dp/B00QUYKX34

MOOCs

1. https://www.mooc-list.com/course/engineering-drawing-gongchengzhitu-edx
2. https://mech.nitk.ac.in/course/machine-drawing

COURSE OUTCOMES: Students are able to:

CO1: Interpret the drawing codes and standards
CO2: Describe standards, abbreviations and symbols
CO3: Sketch the proportions of threads, fasteners and riveted joints.
CO4: Draw the orthographic views with section and without section of machine parts
CO5: Draw the assembly of simple couplings and joints after solving dimensions of their parts

SCHEME OF EXAMINATION

CIE – 50 Marks		
Unit 1		Unit 2 & 3
Test I	AAT I	Test II
20 Marks	05 Marks	25 Marks
SEE = 100 Marks (To be Scaled down to 50 Marks)		
Questions Q1 & Q2 from Unit 1 shall be answered and shall have internal choice.		25 x 1 = 25 Marks
Questions Q3 & Q4 from Unit 2 shall be answered and shall have internal choice.		35 x 1 = 35 Marks
Questions Q5 & Q6 from Unit 3 shall be answered and shall have internal choice.		40 x 1 = 40 Marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H											M
CO2	H									M		M
CO3	H											M
CO4	H	M										M
CO5	H											M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC306L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">WORK SHOP-II</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1 To understand the different conduction of machines.
2 To understand the working principle & operation of machine.
3 To know the operations of different machines to make models.
4 To know the various accessories usage during different operation.
5 To know the safety measures to be taken during different operation.

UNIT- 1

1. Wood Turning :- Three models to be prepared using wood turning Lathe

12 **Hours**

UNIT- 2

General Instructions: Process sheets and Inspection sheets are to be prepared for each model.

1. Detailed study of the following machine tools with regard to their construction, operations and controls: (i) Lathe
2. Demonstration of assembly and disassembly of the following lathe parts: (i) Head Stock (ii) Tail Stock (iii) Carriage (iv) Cross Side (v) Compound Rest (vi) Bed (vii) Gride Ways (viii) Feed Gear Box (ix) Apron Box.
3. Study of accessories chuck (3 jaw & 4 jaw), Face plate, Steady rest, Follower rest, Tool Post & Centers.
4. Four Models using lathe involving, Plain Turning, Taper Turning, Thread cutting, groove cutting, Knurling, Drilling, Boring & Eccentric Turning.
5. Two Models using shaping machine involving production of flat surfaces dove tails, V and rectangular grooves.
6. Grinding of tool angles using tool and cutter grinder machine.
7. Calculation of machining time for turning, drilling, grinding and shaping.

20 **Hours**

COURSE OUTCOMES Students will

CO1: To apply the principles of theory in practical application.
CO2: Indentify the different operation to be performed.
CO3: Develop the design for manufacturing.
CO4: Evaluate the different operations in manufacturing.
CO5: Students can able to analyse the manufacturing of different correspondents

SCHEME OF EXAMINATION

CIE – 50 Marks		
Unit 1		Unit 2
Test I	AAT I	Test II
20 Marks	05 Marks	25 Marks
SEE = 100 Marks (To be Scaled down to 50 Marks)		
Questions Q1 Model from Unit 1		40 x 1 = 40 Marks
Questions Q2 Model from Unit 2		40 x 1 = 40 Marks
Viva Voce		20 Marks

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H											L
CO2	H	M										L
CO3	H											L
CO4	M	M										L
CO5	M											L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC307L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">MATERIAL TESTING LABORATORY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To study the microstructures of engineering materials.
2. To understand and acquire knowledge of the various Non Destructive testing methods.
3. To understand and implement the standard procedure as per ASTM to conduct tests on various equipments.
4. To study the mechanical behaviour of various engineering materials by conducting standard tests.
5. To understand material failure modes and the type of load causing failure.

COURSE CONTENT

Unit -1

1. Metallographic examination of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. To study the defects of Cast and Welded components using Non-destructive tests like: Ultrasonic flaw detection, Magnetic crack detection and Dye penetration testing.
3. Hardness Test on engineering materials using Brinell Hardness Tester, Rockwell Hardness Tester and Vickers Hardness Tester
4. Impact Test on engineering materials using Izod impact tester and Charpy impact tester
5. Shear Test on engineering materials and wood

16 Hours

Unit -2

1. Tension test on engineering materials
2. Bending test on engineering materials and wood
3. Torsion test on engineering materials
4. Compression test on engineering materials
5. Fatigue test (demonstration only)

16 Hours

Text Books

1. Materials Science and Engineering An Introduction William D. Callister, Wiley Publications 10th Edition, 2018
2. Strength of Materials | 3rd Edition Paperback – 1 July 2017 by S S Rattan
3. Mechanical Metallurgy | 3rd Edition by George E. Dieter McGraw-Hill Book Company | 1 July 2017

eBooks / Online Resources

1. **https://link.springer.com/chapter/10.1007/0-387-26691-7_2**

MOOCs

1. **https://stu.westga.edu/~bthibau1/MEDT%207477-Cooper/Calibre%20Library/Dieter_%20George%20Ellwood/Mechanical%20metallurgy%20(13)/Mechanical%20metallurgy%20-%20Dieter_%20George%20Ellwood.pdf**
2. **https://3gaam.com/content/uploads/manual/mechanical-metallurgy-dieter.pdf**

COURSE OUTCOMES Students will

CO1: Analyse the microstructure and identify the Engineering materials.
CO2: Apply the knowledge of NDT methods in related areas.
CO3: Conduct the tests with ASTM standards
CO4: Evaluate the mechanical properties of engineering materials by performing experiments.
CO5: Analyze the material failure

SCHEME OF EXAMINATION.

<table>
<tr><th>Continuous Internal Evaluation (CIE) (Laboratory-50 Marks)</th><th>Marks</th><th colspan="2">Semester End Examination (SEE) (Laboratory-100 Marks)</th><th>Marks</th></tr>
<tr><td>Performance of the Student in the Laboratory every week</td><td>20</td><td rowspan="2">Experiment-1 (Unit-1)
= 30 Marks</td><td>Write up(20% of marks)</td><td>06</td></tr>
<tr><td rowspan="3">Lab record</td><td rowspan="3">20</td><td>Conduction and calculations (80 % of marks)</td><td>24</td></tr>
<tr><td rowspan="2">Experiment-2 (Unit-2) = 50 Marks</td><td>Write up(20% of marks)</td><td>10</td></tr>
<tr><td>Conduction and calculations (80 % of marks)</td><td>40</td></tr>
<tr><td>Lab Test</td><td>10</td><td colspan="2">Viva-Voce</td><td>20</td></tr>
<tr><td>Total (CIE)</td><td>50</td><td colspan="2">Total (SEE)</td><td>50*</td></tr>
</table>

Note:* = SEE shall be conducted for 100 Marks for Practical and the Marks obtained shall be reduced for 50 Marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H											L
CO2	H	M		H								L
CO3	M	H										L
CO4	H			H								L
CO5	M			H								L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Kannada

Scheme and Syllabus - NEP ï 2021

Course Title	**Sanskrutika Kannada - B.Tech (Common to all branches)**					
Course Code	**21KAHS308A**					
Category	**Humanity and Social Science & Management Courses**					
Scheme and Credits	No. of Hours / Week					Semester ï III
	L	T	P	SS	Credits	
	00	02	00	00	01	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100		Duration of SEE: 02 Hrs	

COURSE OBJECTIVES

The course will enable the students:

1. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
2. ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳ ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4. ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಹಾಗೂ ಪ್ರವಾಸ ಕಥನಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಘಟಕ – 1 ಕನ್ನಡ ಸಂಸ್ಕೃತಿ ಮತ್ತು ಭಾಷೆ ಕುರಿತಾದ ಲೇಖನಗಳು **(06 Hrs)**

1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂಪ ನಾಗರಾಜಯ್ಯ
2. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ
3. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ – 2 ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ **(06 Hrs)**

1. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.
2. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
   ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ ï ಕನಕದಾಸರು
3. ತತ್ವ ಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ – 3 ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ **(06 Hrs)**

1. ಡಿವಿಜಿ ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು
2. ಕುರುಡು ಕಾಂಚಾಣ : ದ. ರಾ. ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು

ಘಟಕ – 4 ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ **(07 Hrs)**

1. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ: ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್
2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ – 5 ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ **(07 Hrs)**

1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ
2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

TEXT BOOKS

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ, ಡಾ. ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ.ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

REFERENCE BOOKS

1. ಎಂ. ಚಿದಾನಂದಮೂರ್ತಿ, ಕನ್ನಡ ಸಂಸ್ಕೃತಿ: ನಮ್ಮ ಹೆಮ್ಮೆ, ಪ್ರಕಾಶಕರು–ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.
2. ಕನ್ನಡ–ಕನ್ನಡಿಗ–ಕರ್ನಾಟಕ, ಸಂ. ಎಲ್.ಎನ್. ಶೇಷಗಿರಿರಾವ್, ಡಾ. ಎಂ. ಚಿದಾನಂದಮೂರ್ತಿ, ಸ್ವಪ್ನ ಪುಸ್ತಕಾಲಯ, ಬೆಂಗಳೂರು.
3. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಸ್ಕೃತಿ– ಸಂ. ಎನ್. ಆರ್ ಲಲಿತಾಂಬ, ವಿಶ್ವಾರಾಧ್ಯ, ಪ್ರಸಾರಾಂಗ, ಬೆಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು.
4. ಎಲ್. ಎಸ್ ಶೇಷಗಿರಿರಾವ್, ಹೊಸಗನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಸ್ವಪ್ನ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು.
5. ರಂ ಶ್ರೀ ಮುಗಳಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಗೀತಾ ಬುಕ್ ಹೌಸ್, ಮೈಸೂರು.

EBOOKS / ONLINE RESOURCES

1. https://kn.wikipedia.org/wiki/%E0%B2%95%E0%B2%A8%E0%B3%8D%E0%B2%A8%E0%B2%A1_%E0%B2%B8%E0%B2%BE%E0%B2%B9%E0%B2%BF%E0%B2%A4%E0%B3%8D%E0%B2%AF
2. https://kn.wikisource.org/wiki/%E0%B2%AE%E0%B3%88%E0%B2%B8%E0%B3%82%E0%B2%B0%E0%B3%81_%E0%B2%B5%E0%B2%BF%E0%B2%B6%E0%B3%8D%E0%B2%B5%E0%B2%B5%E0%B2%BF%E0%B2%A6%E0%B3%8D%E0%B2%AF%E0%B2%BE%E0%B2%A8%E0%B2%BF%E0%B2%B2%E0%B2%AF_%E0%B2%B5%E0%B2%BF%E0%B2%B6%E0%B3%8D%E0%B2%B5%E0%B2%95%E0%B3%8B%E0%B2%B6/%E0%B2%95%E0%B2%A8%E0%B3%8D%E0%B2%A8%E0%B2%A1_%E0%B2%B8%E0%B2%BE%E0%B2%B9%E0%B2%BF%E0%B2%A4%E0%B3%8D%E0%B2%AF
3. https://youtu.be/s9ZZRtmj06M

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಕುರಿತು ಅರಿವು ಮೂಡಿರುತ್ತದೆ.

CO2 : ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಕಲಿತು ಹೆಚ್ಚಿನ ಓದಿಗೆ ಮತ್ತು ಜ್ಞಾನಕ್ಕೆ ಸ್ಫೂರ್ತಿ ಮೂಡುತ್ತದೆ.

CO3 : ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಹೆಚ್ಚಾಗುತ್ತದೆ.

CO4 : ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ ಹಾಗೂ ಅವರುಗಳ ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ತಿಳಿದುಕೊಂಡು ನಾಡಿನ ಇನ್ನಿತರ ವ್ಯಕ್ತಿಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳಲು ಕೌತುಕತೆ ಹೆಚ್ಚಾಗುತ್ತದೆ.

CO5 : ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಹಾಗೂ ಪ್ರವಾಸ ಕಥನಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

SCHEME OF EXAMINATION

CIE - 50 Marks			
Unit I, II & III		Unit IV & V	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20 * 5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions Atleast two full questions to be set from each unit Minimum number of sub questions : 2 Maximum number of sub questions : 3 Each full question shall be for a maximum of 20 marks. Answer any *Five* full questions choosing at least one full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1										M		M
CO2										M		M
CO3										M		M
CO4										M		M
CO5										M		M

L - Low, M - Medium, H - High

BANGALORE UNIVERSITY

Department of Kannada

Scheme and Syllabus - NEP ï 2021

Course Title	**Balake Kannada - B.Tech (Common to all branches)**					
Course Code	**21KAHS308B**					
Category	**Humanity and Social Science & Management Courses**					
Scheme and Credits	No. of Hours / Week					Semester ï III
	L	T	P	SS	Credits	
	00	02	00	00	01	
CIE Marks: 50	SEE Marks: 50	Total Max. Marks: 100			Duration of SEE: 02 Hrs	

COURSE OBJECTIVES

The course will enable the students:

1. To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. To enable learners to Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To train the learners for correct and polite conservation.
5. To know about Karnataka state and its language, literature and General information about this state.

Unit – 1 **(06 Hrs)**

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

Unit – 2 **(06 Hrs)**

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು ï Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು – Qualitative, Quantitative and Colour Adjectives, Numerals.

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3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ ï (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) - Predictive Forms, Locative Case.

Unit – 3 **(06 Hrs)**

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

Unit – 4 **(07 Hrs)**

1. ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು – Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು– Accusative Cases and Potential Forms used in General Communication

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3. "ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು ï Helping Verbs ñiru and irallaò, Corresponding Future and Negation Verbs.
4. ಹೋಲಿಕೆ (ತರತಮ), ಸಂಬಂಧ ಸೂಚಕ, ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ – Comparative, Relationship, Identification and Negation Words.

Unit – 5 **(07 Hrs)**

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of Tense, Time and Verbs.
2. ದ್, –ತ್, –ತು, –ಇತು, –ಆಗಿ, –ಅಲ್ಲ, –ಗ್, –ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ – Formation of Past, Future and Present Tense Sentences with Verb Forms

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3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು– Kannada words in Conversation.

TEXT BOOKS

1. **ಬಳಕೆ ಕನ್ನಡ, ಡಾ.ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಕಟಣೆ: ಪ್ರಸಾರಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.**
2. **ಕನ್ನಡ ಕಲಿಕೆ – ಕ್ರಿಯಾ ಕನ್ನಡ, ಪ್ರಸಾರಂಗ, ಡಾ. ಏ. ನಾಗಭೂಷಣ, ಸಂ. ಎನ್. ಆರ್. ಲಲಿತಾಂಬ, ಪ್ರಸಾರಂಗ, ಬೆಂಗಳೂರು.**

REFERENCE BOOKS

1. **ಕನ್ನಡ ಕಲಿ–ಲಿಂಗದೇವರು ಹಳೆಮನೆ, ಪ್ರಸಾರಂಗ, ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.**
2. **ಕನ್ನಡ ನುಡಿಘಟ್ಟ–1, ಭ. ಮಲ್ಲಿಕಾರ್ಜುನ, ಕೆ.ಆರ್. ಸದಾನಂದ, ಭಾರತೀಯ ಭಾಷಾ ಸಂಸ್ಥಾನ, ಮಾನಸಗಂಗೋತ್ರಿ, ಮೈಸೂರು.**
3. **ವ್ಯವಹಾರಿಕ ಕನ್ನಡ ಮಾತು ಮತ್ತು ಬರಹ, ಪ್ರೊ. ಜಿ. ಅಬ್ದುಲ್ ಬಷೀರ್, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್, ಬೆಂಗಳೂರು.**

EBOOKS / ONLINE RESOURCES

1. https://youtu.be/k_JB0wkt1_4
2. https://youtu.be/fd966GC8Yko
3. https://play.google.com/store/apps/details?id=app.learnkannada.com.learnkannadakannadakali
4. https://bengaluru.citizenmatters.in/how-to-learn-kannada-bangalore-kannada-classes-online-5523

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1 : To understand the necessity of learning of local language for comfortable life.
CO2 : To speak, read and write Kannada language as per requirement.
CO3 : To communicate (converse) in Kannada language in their daily life with Kannada speakers.
CO4 : To Listen and understand the Kannada language properly.
CO5 : To speak in polite conservation.

SCHEME OF EXAMINATION

CIE - 50 Marks			
Unit I, II & III		Unit IV & V	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20 * 5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions Atleast two full questions to be set from each unit Minimum number of sub questions : 2 Maximum number of sub questions : 3 Each full question shall be for a maximum of 20 marks. Answer any *Five* full questions choosing at least one full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1										M		M
CO2										M		M
CO3										M		M
CO4										M		M
CO5										M		M

L - Low, M - Medium, H - High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEIN309</td><td colspan="3">B. Tech (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="4">Internship</td><td colspan="2">Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">SUMMER INTERNSHIP-I</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours: 02 to 04 weeks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 2 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students:

1. To apply relevant knowledge and skills acquired during the program.
2. To analyse, carry out and identify the solution for the present problem formulation in the organisation.
3. To finalize the specification of the problem and to work out, prepare project plan and methodology, considering professional, cultural and societal factors.
4. To develop experimental planning and select appropriate techniques and tools to conduct experiments to evaluate and critically examine the outcomes of the problems in the organization.
5. To develop oral and written communication skills to effectively convey the technical content.

COURSE CONTENT

GUIDELINES:

Internship is a programme in which during the intervening period of II & III semesters Innovation / Entrepreneurship/ Societal based Internship.

1. All the students shall have to undergo a mandatory internship of 02 to 04 weeks during the intervening period of III semesters without affecting the Academic Classes.

2. The internship shall be slated for CIE and SEE. The grade earned through CIE and SEE shall be included in the grade card.

3. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

4. Students may choose to work on innovation or entrepreneurial activities or both resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

5. In case students want to undergo summer internship-I at his/her family business, he /she shall will be permitted provided; a declaration by a parent is submitted directly to the principal of the institution.

6. With the consent of the internship guide and Principal of the institution, students shall be allowed to carry out the internship at their hometown (within and outside the state), provided favorable facilities are available.

7. In case, students wish to take both Innovation, and Entrepreneurship internship, they shall be permitted to take up both. Summer Internship - I period, in such cases, can extend marginally by few days, provided it will not interfere with the academic calendar of higher semester

- Summer Internship-I is offered at Institute Level/Companies to be carried out during the vacation after the II semester and before the commencement of III semester for duration of 02 to 04 weeks.

- Summer Internship - I shall include Inter / Intra Institutional activities. A University Viva-voce examination (Presentation followed by question-answer session) shall be conducted during the III semester and the prescribed credit shall be included in the III semester.

- The Summer Internship - I shall be considered as a head of passing and shall be considered for the award of a degree.

- Those, who do not take up / complete the Summer Internship - I shall be declared fail and shall have to complete during subsequent University examination after satisfying the Summer Internship - I requirements.

- The faculty coordinator or mentor has to monitor the student's internship progress and interact to guide them for the successful completion of the Summer Internship -I

- While intra activities are within the institution, inter activates shall be between the concerned institution and neighboring institutions. Intra and Inter activities are the activities that are impetus to learning techniques. It adds to comprehensive growth of mind and associated activities.

Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Nongovernment organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers.

Innovation need not be a single major break-through , it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company.

This experience can then be applied to future business endeavors. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as

learning how a small business operates will serve the intern well when he/she manages his/her own company.

Societal or social internship. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and many things that urban population enjoys.

Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

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

COURSE OUTCOMES: Students will

CO1: Apply appropriate workplace behaviors in a professional setting.
CO2: Demonstrate content knowledge appropriate to job assignment.
CO3: Exhibit evidence of increased content knowledge gained through practical experience.
CO4: Describe the nature and function of the organization in which the internship experience takes place.
CO5: Explain how the internship placement site fits into a broader career field.
CO6: Evaluate the internship experience in terms of personal, educational and career needs.

SCHEME OF EXAMINATION

Each faculty member is to be assigned 2 to3 batches of students each batch may have 4 or 5 students. The assessment is to be conducted for 50 marks for CIE and 100 Marks for SEE and reduced to 50 marks to be incorporated in the result. Internship Seminars has to be presented once in 15 days with the concern of the respective Guide/s, Coordinator and Chairperson about the progress of the Summer Internship -I.

For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Topic of internship	10%	50
2.	Objectives of internship	10%	
3.	Specific skills acquired	20%	
4.	Documentation	40%	
5.	Presentation	20%	
Total		100%	

Each student is required to maintain an individual logbook, where he/she is supposed to record day to day activities. The Internship -I is assessed on an individual basis, thus allowing for individual members within groups to be assessed this way. The assessment will take into consideration the individual student's involvement in the assigned work.

Rubrics for SEE:

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Topic of internship	10%	100 To be reduced to 50
2.	Objectives of internship	10%	
3.	Specific skills acquired (Write up about in Internship)	20%	
4.	Presentation	40%	
5.	Viva-Voce	20%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H									H
CO2	H	H	M									M
CO3	H	H	M									M
CO4	H	H	M									H
CO5	H	H	H									H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEAE310L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Ability Enhance Course</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">Computer Aided Drafting/Modeling Lab</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To understand basic structure of CAD systems and their applications.
2. To interact with ICGS through various inbuilt commands for geometry creation.
3. To apply geometrical transformations for modifying CAD models.
4. To understand basic concepts of 3D modeling and viewing.
5. To create 3D model of machine components and generate engineering drawing.

UNIT- 1

Introduction

Concept of CAD, Need & Importance of CAD, Overview of a CAD software, System Requirements, Workbenches, Customizing CAD software; managing workspace, menu and toolbars. Starting new drawing, finding tools for selecting/moving objects with mouse, working with planes, graphic properties toolbar, changing the graphic properties, changing the interface from 3D modeling to 2D sketching and vice-versa. **03 Hours**

UNIT- 2

Sketching

Introduction to sketching and its concept, entering/exiting the sketcher, coordinate systems, profile creation tools for creating 2D sketch, modifying the sketch created, tools for changing visualization and orientation of sketch. Creating basic sketches using commands such as lines, circle, polygons, etc., pre-defined profiles, user-defined profiles, setting units, constraining the sketch with dimensional constraints and geometrical constraints. Editing the sketches using trim, mirroring an object, placing/making an object in a symmetrical position, translation, rotation and scaling an object, offset, adding dimensions and sketch analysis and quick geometry diagnosis

Exercise sketching / drafting of simple geometry comprises of line, circle, arc and curves and sketching orthographic views of Machine parts. 09 Hours

UNIT- 3

Part Modeling

Concept of 3D and part modeling, creating base features and modifying them, converting a sketch into part, concept of volumetric designing, creating volume in linear

direction (extrude), creating a cavity in volume in linear direction (cutouts) and their limitations. creation of volume in circular shape (shaft), removal of volume in circular shape (groove), restrictions of revolved features, creation/removal of volume on pre-defined path (rib/slot), creation of hole using positioning sketch, hole creation using pre-defined references, introduction to stiffeners, creating a new volume using two different sketches (solid combine).

Apply geometric transformation to modify part model: Mirroring single/multiple feature with respect to plane, use of standard pattern styles (rectangular pattern, circular pattern), translating an object/body from its original position, rotate an object/body from its position with respect to axis, placing the body/object in a symmetrical position with respect to plane, change the scale of the body by selecting different faces or with axis system.

Exercise part modeling of simple machine parts. **10 Hours**

Unit- 4

ASSEMBLY MODELING

What is an assembly, defining a new assembly document, use of compass in assembly, importing existing components in a new assembly. Degree of freedom in the assembly constraint creation, analyzing created constraints, assembly features, making pattern of any object, using existing assemblies to create a product structure, Editing previously created part/assembly in assembly features, exploding a constrained assembly, reordering product structure, reusing a component (copy/paste), saving an assembly document, opening/loading an assembly.

GENERATIVE DRAFTING

Introduction, taking projection of front view on sheet, generating different views such as top view etc., Difference between primary and secondary view, modifying an existing view, generative dimensions, balloon generation for drafting of assembly.

Exercise assembly modeling and generation of drawing of Joints and Couplings.

10 Hours

REFERENCE BOOKS

1. CATIA Reference Guide Book**,** Publisher: CAD DESK (1 January 2019)

2. AUTOCAD Reference Guide BoOK Paperback – 1 January 2020, by CAD Desk

MOOCs

1. https://www.mooc-list.com/course/autodesk-certified-professional-inventor-mechanical-design-exam-prep-coursera
2. https://nptel.ac.in/courses/112102101“Computer Aided Design and Manufacturing, IIT Delhi”

COURSE OUTCOMES Students will be able to:

CO1: Implement concept of engineering drawing through ICGS to create sketches.
CO2: Investigate geometrical transformations to modify the sketches created.
CO3: Model the machine parts using inbuilt commands with speed and accuracy.
CO4: Improvise model manipulation through rendering and viewing.
CO5: Generate drawing from model of machine parts created.

SCHEME OF EXAMINATION

Continuous Internal Evaluation (Laboratory– 50 marks)	**Marks**	**Semester End Evaluation (SEE) (Laboratory – 100 marks)**	**Marks**
Performance of the student in the laboratory every week	25	Exercise-1 (Unit 3) = 30 marks Exercise-2 (Unit 4) = 50 marks	80
Test at the end of the semester Exercise-1(Unit 3) =10marks Exercise-2 (Unit 4) = 10 marks	20		
Viva Voce	05	Viva Voce	20
Total (CIE)	**50**	**Total**	**100 ***

Note: * SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H				M							M
CO2	H		H									M
CO3	H				M							M
CO4	H		M		M							M
CO5	H			H								M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="5">21UHV311</td><td colspan="2">B. Tech. (Common to all braches)</td></tr>
<tr><td>Category</td><td colspan="6">Universal Human Value Courses</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="7">Universal Human Values – I</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours=16</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>CIEMarks:50</td><td colspan="2">SEE Marks:50</td><td colspan="3">Total Max.Marks:100</td><td colspan="2">Duration of SEE: 2Hrs</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings?

2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

COURSE CONTENT

UNIT- 1

Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution. **03 Hours**

UNIT-2

Right Understanding (Knowing)- Knower, Known & the Process The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).

03 Hours

UNIT-3

Understanding Human Being Understanding the human being comprehensively as the

first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self. **03 Hours**

UNIT-4

Understanding Nature and Existence A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence). **03 Hours**

UNIT-5

Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behaviour and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence. **04 Hours**

Text Books

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.

References Books:

1. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
2. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
3. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
4. A N Tripathy, 2003, Human Values, New Age International Publishers.
5. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
6. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press.
7. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
8. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
9. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

eBooks / Online Resources

1. https://fdp-si.aicte-india.org/download/Realising%20Apsirations%20of%20NEP2020-UHV%20v28.pdf
2. https://www.researchgate.net/publication/344499298_A_Textbook_on_Human_Values_and_Ethics.

3. https://books.google.co.in/books?id=nKQL3uqeYMC&printsec=copyright&redir_esc=y#v=onepage&q&f=false.

MOOCs

1. https://nptel.ac.in/courses/109104068
2. http://www.nitttrc.edu.in/nptel/courses/video/109104115/lec36.pdf
3. https://www.youtube.com/watch?v=9-8gdnBJK1w
4. https://www.youtube.com/watch?v=9LSEBK03CiY

COURSE OUTCOMES Students are able to:

CO1: Evaluate the significance of value inputs in formal education and start applying them in their life and profession.
CO2: Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3: Analyze the value of harmonious relationship based on trust and respect in their life and profession.
CO4: Examine the role of a human being in ensuring harmony in society and nature.
CO5: Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

SCHEME OP EXAMINATION

CIE-50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			
• There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any Five questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1						M		M				
CO2						H		M				
CO3						H		M				
CO4						H		M				
CO5						M		H				

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

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Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21BSBM312</td><td colspan="3">B. Tech. (Common to all braches except Civil Engineering branch)</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">BRIDGE MATHEMATICS –I (Lateral Entry Students)</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours=50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIEMarks:50</td><td colspan="2">SEE Marks:50</td><td colspan="3">Total Max.Marks:100</td><td>Duration of SEE: 3Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. Study the applications of successive differentiation, Rolls and Mean value theorems.
2. Study the applications of curvature and radius of curvature.
3. Be skilled in computations and applications of partial differentiations and Jacobians.
4. Be able to solve the three dimensional geometry problems which appear in engineering problems.
5. Be skilled in computations and applications of infinite series and sums and analyse a nature of the given series.

COURSE CONTENT

Unit- 1

Successive differentiation: n^{th} derivative of some standard function, Leibnitz theorem, and problems, polar curves and angle between the polar curves, Rolle's theorem, Lagrange and Cauchy Mean value theorem and applications, Applications of Taylor and Mc Laurin expansion for a single variable (without proof). Indeterminate forms, evaluation of limits by L-Hospital rule (without proof). ` **10Hours**

Unit- 2

Derivative of an arc in Cartesian, parametric and polar forms. Curvature of plane curves-formula for radius of curvature in Cartesian, parametric, polar forms. **10Hours**

Unit- 3

Partial differentiation: First and higher order derivatives, Euler theorem, Total differentiation, differentiation of implicit functions and composite functions, Jacobeans. **10 Hours**

Unit- 4

Analytical geometry in three dimensions: Direction cosines and direction ratios, planes, straight lines. Angle between planes/straight lines, coplanar lines, shortest distance between skew lines, Right circular cone and right circular cylinder. **10Hours**

Unit- 5

Sequence and Series: Convergence ,divergence and oscillation of an infinite series, comparison tests, p series, D'Alembert's ration test, Rabees's test. Cauchy's root test, Cauchy's integraltest (all tests without proof) for series of positive terms. **10Hours**

Text Books

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2015.
3. D. S. Chandrashekaraiah," Engineering Mathematics-III", Prism Books Pvt. Ltd. 7th Ed., 2014.

Reference Books:

1. B. V .Ramana "Higher Engineering Mathematics" Tata McGraw - Hill, 2006
2. N. P. Baliand M. Goyal, "A text book of Engineering mathematics", Laxmi publications, latest Edition.
3. H. K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand publishing, 1st Ed., 2011.

E-Books:

1. http://tutorial.math.lamar.edu/Classes/CalcII/CalcII.aspx
2. http://www.ec.unipg.it/DEFS/upload.linalg_evals_evects.pdf
3. https://www.math.ku.edu/~lerner/LAnotes?LAnotes.pdf
4. https://ocu.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/vidoe-lectures/(GilbertStrangvediolectures)
5. http://nptel.ac.in/downloads/122101003(lecturenotes)

MOOC/NPTEL

1. http://nptel.ac.in,
2. http://academicearth.org

COURSE OUTCOME Students will be

CO1: Students will use of n^{th} derivatives, solve problems of Rolls and Means value theorems and indeterminate forms.
CO2: Finding the derivative of an arc in Cartesian, parametric, polar forms.
CO3: Use partial differentiation determine Jacobins.
CO4: Three dimensional geometry problems and properties.
CO5: Compute infinite series, sum an infinite series, and analyse a nature of the given series.

SCHEME OF EXAMINATION

CIE-50 Marks			
Unit1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			

- There shall be 10 questions
- Two full questions to be set from each unit with internal choice.
- ✓ Minimum number of sub questions : 2
- ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any Five questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H										H
CO2	H	H										H
CO3	H	H										H
CO4	H	H										H
CO5	H	H										H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21BSEM401</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science</td><td>Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">ENGINEERING MATHEMATICS -IV</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. To understand range of analytic functions and concerned results.
2. Understand and find Taylor series and determine their intervals of convergence.
3. Solve an algebraic or transcendental equation using an appropriate numerical method.
4. Solve boundary value problems using the finite difference method.
5. Being aware of exact, approximate and numerical methods to solve the resulting equations.

COURSE CONTENT

Unit- 1

Sets in a complex plane – Functions of a complex variables. Limit, Continuity and differentiability (definitions only). Analytic function- Riemann equations in Cartesian and polar forms. Harmonic functions, Constructions of analytic functions (Cartesian and polar forms).

Line integral - Cauchy's theorem - corollaries. Cauchy's formula complex function and for derivatives, Conformal transformations : $\frac{1}{z}$,z^2,e^zandz +$\frac{a^2}{z}$($z \neq 0$) Bilinear transformations.

10 Hours

Unit- 2

Power series, convergence ,radius of convergence, Taylor's and Laurent's theorems (Statements only) Singularities. Poles Calculation of residues. Residue theorem (without proof)-problems. Evaluation of Contour integrals.

10 Hours

Unit- 3

Numerical solution of algebraic and transcendental equations – solution by Bisection, Ramanujan method, linear iteration and Newton –Raphson methods. Solution of linear simultaneous equations: Gauss elimination method, Gauss Jordan method, Gauss Seidel

methods, LU decomposition method, methods of Crout, Doolittle and Cholesky.

10Hours

Unit- 4

Finite differences (Forward and backward differences), Interpolation, Newtons forward and backward interpolation formulae, Central difference formulae: stirlings and Bessels formula. Interpolation with unequal spaced points: Lagarange interpolation formula, and inverse interpolation formulae. Divided differences and their properties: Newtons general interpolation formula. Interpolation by iteration, Numerical differentiation using Newtons forward and backward interpolation formulae, Numerical integration: Trapezoidal method, Simpson's 1/3rule Simpon's $3/8^{th}$rule. **10Hours**

Unit- 5

Numerical solution of ordinary differential equations: Solution by Taylor's series, Picard's method of successive approximation, modified Euler's method, Runge - Kutta methods of second and fourth order, Predictor and corrector methods – Adams –Bashforth method, Adams Moultons method. **10Hours**

Text Books

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43^{rd} Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10^{th} Ed., 2015.
3. B.V.Ramana"HigherEngineeringMathematics"TataMcGraw-Hill,2006
4. N. P. Baliand M. Goyal,"A text book of Engineering mathematics", Laxmi publications, latest Ed.
5. H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand publishing, 1^{st}Ed. 2011.

References Books:

1. S. S. Sastry, Introductory methods of Numerical Analysis, 3^{rd} Ed., Prentice-Hall India.
2. M. K. Jain,S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation, New Age international Publishers.

eBooks / Online Resources

1. https://books.google.co.in/books/about/Solutions_to_Engineering_Mathematics_Vol.html ?id=doxyRIJwCQMC&redir_esc=y
2. https://www.pdfdrive.com/engineering-mathematics-fourth-edition-e158638551.html
3. https://www.ncertbooks.guru/engineering-mathematics/

MOOCs

1. https://nptel.ac.in/courses/111105121.
2. https://www.classcentral.com/course/swayam-advanced-engineering-mathematics-13006.

COURSE OUTCOMES: Students are able to:

CO1: Understanding necessary and sufficient condition for analytic function and Cauchy's integral formula.
CO2: Express the length of a curve as a (Riemann) sum of linear segments, convert to definite integral form and compute its value.
CO3: Approximate a function using an appropriate numerical method.
CO4: Solve boundary value problems using the finite difference method.
CO5: Being aware of exact, approximate and numerical methods to solve the resulting equations.

SCHEME OF EXAMINATION

CIE-50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			

- There shall be 10 questions
- Two full questions to be set from each unit with internal choice.
- ✓ Minimum number of sub questions : 2
- ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any Five questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H										H
CO2	H	H										H
CO3	H	H										H
CO4	H	H										H
CO5	H	H										H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC402**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: IV**
Course title	**KINEMATICS OF MACHINES**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1 To Apply the basic concepts and working of various mechanisms and their applications.
2 To Analyse the position, velocity and acceleration of various components of mechanisms.
3 To Create the mechanism of converting one form of motion to another form.
4 To Evaluate the power transmitting mechanism and capacity of belt, rope and chain drives.
5 To Evaluate the velocity ratio and power transmitting capacity of various gear drives.

COURSE CONTENT

Unit- 1

Types of Constrained Motion, Rigid and Resistant Bodies, Types of links, Kinematic Pairs, Kinematic Chain, Mechanism and Structure, Inversions of Mechanisms, The Four-Bar Chain, The Slider-Crank Chain, Double Slider-Crank Chain, Quick Return Motion Mechanism, Intermittent Motion Mechanisms: Rachet and Pawl Mechanisms, Geneva Wheel, Straight line motion: Peaucellier mechanism, Watt's Straight line mechanism Pantograph.

10 Hours

Unit- 2

Velocity and acceleration of Mechanisms by Relative Velocity method, Instantaneous Centre Methods, Kleins constructions, Numerical Problems.

10 Hours

Unit- 3

Introduction to Mobility of Mechanisms and Degree of freedom, Types of Cams and Followers, Definitions, Follower Displacement Diagrams, Layout of Cam profiles, Cams with Specified Contours, Numerical Problems. **10 Hours**

Unit- 4

Belt drives: Open-Belt and Crossed-Belt Drives, Types of Pulleys, Law of Belting, Length of Belt, Ratio of Belt Tensions, Power Transmitted, Centrifugal Effect on Belts, Maximum Power Transmitted by a Belt, Initial Tension, Creep, Rope Drives, Chains drives, Numerical Problems. **10 Hours**

Unit- 5

Classification of Gears, Gear Terminology, Law of Gearing, Velocity of Sliding, Cycloidal and Involute Profile Teeth, Path of Contact, Arc of Contact, Number of Pairs of Teeth in Contact (Contact Ratio), Interference in Gears, Minimum Number of Teeth, Gear Trains, Differentials, Numerical Problems. **10 Hours**

Text Books:

1. Theory of Machines, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi,3rd Edition, 2009.
2. Theory of machines, RK Bansal and Guptha.

References Books:

1. Theory of Machines by J.E. Shiegley, Vicker, McGraw Publication.
2. Mechanisms and Dynamics of Machinery by Hamilton, H. Mabie and Charles F. Rein Holtz., John Wiely Publishers.
3. Theory of mechanisms - P.L. Ballaney
4. Theory of machines,- Thomas Bevan
5. Theory of machines- Abdulla sharief
6. Theory of Machines- Sadhu Singh, Pearson Education. 2nd edition. 2007.
7. Kinematics of machines- JBK Das and PL Srinivasamurthy, Swapna book publishers
8. Kineatics of Machines- AS Ravindra.

eBooks / Online Resources

1. https://www.e-booksdirectory.com
2. https://www.wonderslate.com
3. https://www.kobo.com

MOOCs

1. https://www.azdocuments.in/2020/02/kinematics-of-machines18me44.html
2. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_KOM_LECTURE_NOTES_0.pdf
3. https://nptel.ac.in/courses/112104121
4. https://nptel.ac.in/courses/112106270

COURSE OUTCOMES: Students will

CO1: Apply the basic concepts and working of various mechanisms to create the simple models.
CO2: Analyze the velocity and acceleration at various positions in mechanisms.
CO3: Create the cam profile for converting one form of motion to define another form.
CO4: Evaluate the various power transmitting mechanism and capacity of drives.
CO5: Evaluate the velocity ratio and power transmitting capacity of various gear drives

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	M	L								
CO2	H	M	M	L								L
CO3	H	M	M	L								
CO4	H	M	M	L								L
CO5	H	M	M	L								

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC403**			**B. Tech (Mechanical Engineering)**		
Category	Professional Core					**Semester: IV**
Course title	**MANUFACTURING PROCESS - I**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To provide adequate knowledge of quality test methods conducted on welded and cast components.
2. The students have to learn Process information of various casting techniques in manufacturing.
3. To provide in-depth metallurgical aspects during solidification of metal and alloys.
4. To enrich the knowledge of various joining process used in manufacturing.
5. To learn the various techniques about behaviour of materials during welding, and the effect of process parameters in welding,

COURSE CONTENT

Unit- 1

Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy.

Introduction to casting process & steps involved:

Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand moulding: Types of base sand, requirement of base sand. Binder, Additives definition, need and types; preparation of sand moulds. Melding machines - Jolt type, squeeze type and Sand-Slinger.

Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2 mould, shell mould, investment mould, plaster mould, cement bonded mould.

Cores: Definition, need, types. Method of making cores,

Concept of gating: (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types **10 Hours**

Unit- 2

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.

Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Introduction to Nonferrous foundry practice Aluminium castings – advantages and limitations

10 Hours

Unit- 3

Solidification: Definition, nucleation, solidification variables. Directional solidification-need and methods. Degasification in liquid metals-sources of gas, degasification methods.

Fettling and cleaning of castings: Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process. **10 Hours**

Unit- 4

Welding process: Arc welding Principle, Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW).

Special type of welding: Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Termite welding, Laser welding and Electron beam welding. **10 Hours**

Unit- 5

Metallurgical Aspects In Welding: Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds& Residual stresses. Concept of electrodes, filler rod and fluxes. Welding defects- detection causes & remedy.

Inspection methods: Methods used for inspection of casting and welding. Visual magnetic particle, fluorescent particle, ultrasonic. Radiography, eddy current, holography methods of inspection. **10 Hours**

Text Books:

1. Manufacturing Technology Vol I & II, P.N.Rao, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1998
2. Workshop Technology Vol. I and II, Chapman W. A.J., Arnold Publisher New Delhi, 1998
3. Elements of Manufacturing Technology Vol-1, Hajra Choudhary, S. K. and Hajra Choudhary, A. K., Media Publishers, Bombay, 1988
4. Principles of metal casting, Richard W. Heine, Carl R. Loper Jr., Philip C. Rosenthal, Tata McGraw Hill Education Private Limited, 1976

References Books:

1.Sharma, P. C., A Text book of Production Engineering, New Delhi, 1995

2.Pandey and Sha, Modern Manufacturing Process, Prentice Hall, New Jersey.

3.HMT Production Technology, Tata McGraw Hill, 2001

4.Manufacturing Technology-Foundry, Forming, P.N.Rao, Tata McGraw Hill, 3rd Ed., 2003.

eBooks / Online Resources

1.https://alison.com/course/introduction-manufacturing-processes

2.https://www.udemy.com/course/manufacturing-process-selection-and-design-for-manufacturing/

MOOCs

1. https://www.digimat.in/nptel/courses/video/112107145/L01.html

COURSE OUTCOMES: Students will

CO1: Describe the casting process and prepare different types of cast products.models.

CO2: Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, and Sand Slinger Moulding machines.

CO3: Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces

CO4 Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.

CO5: Understand the Solidification process and Casting of Non-Ferrous Metals.

CO6: Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. used in manufacturing.

CO7: Describe methods for the quality assurance of components made of casting and joining process

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L		M							L
CO2	H	M	L		M							
CO3	M	L			H							L
CO4	M	M			M							
CO5	M	M			M							L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC404</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">APPLIED THERMODYNAMICS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To enrich the knowledge of students in thermodynamics.
2. To understand the basics of Vapour cycles and Compressors.
3. To know the concepts of Gas Turbines and Jet Propulsions.
4. To analyse the Properties of Refrigeration and Air conditioning associated with the thermodynamic processes.
5. To get the basic knowledge about Alternative fuels and Pollutions.

COURSE CONTENT

Unit- 1

Air Standard Cycles: air standard efficiency & - MEP of Otto cycle – diesel cycle – dual combustion cycle numerical problems - deviation of real cycle from theoretical air cycle, numerical problems. Performance and Testing of IC Engines: Introduction: Indicated power - Brake power - Various I.C. engine efficiencies - Specific fuel consumption - Heat balance sheet Measurement of IP of IC engines - Performance curves for SI engines - Variables effecting engine performance - Power requirement and power available curve problems. **10 Hours**

Unit- 2

Vapour power cycles: Cornet vapour cycle, draw backs as a reference cycles, simple Rankine cycle, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles, effects of pressure and temperature on Rankine cycle performance. Actual power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters, reheat Rankine cycles. Numerical Problems 1**0 Hours**

Unit- 3

Refrigeration: Introduction-Application of refrigeration - Performance of a refrigerator (COP) - Units of refrigeration - The reverse cannot cycle - The reversed Brayton or Bell Coleman air cycle - Air refrigeration system - Vapour compression refrigeration system - Methods to improve simple refrigeration system - Properties of a good refrigerant – Vapour absorption refrigeration System –COP in terms of operating temperatures of vapour absorption refrigeration system -

Electrolux refrigeration system - Steam jet refrigeration system – Non conventional refrigeration systems -Thermoelectric refrigeration - Pulse tube refrigeration - Vortex tube refrigeration - Concept of low temperature refrigeration, wet bulb dry bulb, RH psychometric chart. Numerical Problems **10 Hours**

Unit- 4

Displacement Compressors:- Use of compressed air - Reciprocating compressors - single stage compressor without clearance and without clearance volumetric efficiency - Best value for index of compression - Multistage reciprocating air compressors - minimum work input in multi stage compression - Heat rejected per Kg of air - Indicators diagram - Mean effective pressure - Indicated power - shaft power - Optimum intermediate pressure in two stage compressors - Numerical problems.

Fundamentals of Electric vehicles: Overview of Electric Vehicles in India, Vehicle Dynamics, Vehicle Subsystems: EV Power-train, Storage for EVs, Fundamentals of EV Battery Pack design, EV Motors and Controllers: Fundamentals and Design, Vehicle Accessories, Battery Charging and Swapping. **10 Hours**

Unit- 5

Alternative fuels: Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels, Scenario of conventional auto fuels, fuel quality aspects related to emissions. Technological up gradation required, business driving factors for alternative fuels. Implementation barriers for alternative fuels. **Pollution control techniques:** Formation of White, Blue, and Black Smoke, NOx, soot, sulphur particulate and Intermediate Compounds - Physical and Chemical delay- Significance Effect of operating variables on Emission formation- Fumigation, Split injection, Add Blue, Catalytic Coating, EGR, HCCI, Particulate Traps, SCR. **10 Hours**

Text Books:

1. Engineering Thermodynamics, R K Rajput, 4th Edition, Laxmi Publications Pvt. Ltd., 2010
2. Basic and Applied Thermodynamics, P. K. Nag, 2nd Edition, Tata McGraw Hill, 2009

References Books:

1. Thermodynamics: An Engineering Approach, Yunus A. Cengel and Michael A. Boles, 7th Edition, Tata-McGraw hill Pub, 2011.
2. Fundamentals of Thermodynamics, Gordon J. Van Wylan& Richard E Sonntagg, 7th Edition, Wiley Eastern Ltd, 2009.
3. Engineering Thermodynamics, J.B. Jones and G. A. Hawkins, John Wiley and Sons.
4. Thermo Dynamics, S. C. Gupta, 1st Edition, Pearson Edu. Pvt. Ltd., 2005.
5. Elements of heat Engines (Vol I, II, III), R.C. Patel and C.J. Karamchandani, Acharya Publications, 2010

eBooks / Online Resources

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Ed., Phi Learning, 2005
3. http://www.nptel.ac.in/syllabus/112106133/

MOOCs

1. https://www.edx.org/course/thermodynamics-iitbombayx-me209-1x
2. https://legacy.saylor.org/me103/Intro
3. https://www.coursera.org/course/introthermodynamics

COURSE OUTCOMES: Students will

CO1: Apply the first and second laws of thermodynamics in the analysis of energy components to determine the properties pertaining to thermodynamic-cycles.
CO2: Analyze the thermodynamic-cycles of internal combustion engines in order to evaluate its performance.
CO3: Assess benefits of improvements to thermodynamic systems.
CO4: Investigate the performance of thermodynamic systems for their performance.
CO5: Synthesis & interpret the experimental data of thermal systems.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M										H
CO2	M	H	L									H
CO3	H	H										M
CO4	H	M										M
CO5	M	M	L									H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC405L**			**B. Tech (Mechanical Engineering)**		
Category	Professional Core					**Semester: IV**
Course title	**MACHINE DRAWING -II**					
Scheme and Credits	No. of Hours/Week					Total hours = 32
	L	T	P	SS	Credits	
	0	0	3	0	1	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. Apply the conventional representation of materials, common machine elements such as screw, bolts, nuts, keys, webs or ribs and parts not to be sectioned.
2. Learn the applications of an given assembly,
3. Understand the significance of different parts of an assembly.
4. Analyze the given part drawing to understand their sequence of assembly/sub-assembly.
5. To draw orthographic views of assembly from given part drawing with and without section.

COURSE CONTENT

Unit- 1

Drawing the 3 principal views of the following assembly, of which one view in section/half section, when detailed part drawings are given. Important dimensions are to be marked, part numbering and part list have to be shown.

1. Screw Jack
2. Plummer Block
3. Swivel Bearing
4. Feed check valve
5. Non return valve
6. Machine Vice
7. Tailstock
8. Petrol Engine Connecting Rod **(8X4 = 32 Hours)**

Text Books:

1. Machine Drawing: K. R. Gopalkrishna, Subhas Publications

References Books:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing house, Anand, New Delhi, 28th 3rd edition,
2. N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co. Ltd., 5th edition, 1994

3. K.L. Narayana, P.Kannaiah, K.Venkat Reddy, Machine Drawing, New Age International (P)Ltd., 2nd edition 1999.
4. K. C. John, Text book of Machine Drawing, PHI Learning

eBooks / Online Resources

1. https://easyengineering.net/machine-drawing-by-narayana
2. https://Textbook-Machine-Drawing-R-K-Dhawan-ebook/dp/B00QUYKX34

MOOCs

1. https://www.mooc-list.com/course/engineering-drawing-gongchengzhitu-edx
2. https://mech.nitk.ac.in/course/machine-drawing

COURSE OUTCOMES: Students will

CO1: Interpret the conventional representation of machine parts
CO2: Describe the function of an assembly of parts
CO3: Interpret the dimensional relationship between the parts of an assembly
CO4: Visualize Assembly of the parts
CO5: Draw the orthographic views with section and without section of an assembly

SCHEME OF EXAMINATION

<table>
<tr><th colspan="3">CIE – 50 Marks</th></tr>
<tr><th colspan="3">Unit- 1</th></tr>
<tr><td>Test I</td><td>AAT I</td><td rowspan="2">Test II
25 Marks</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="3">SEE = 100 Marks (To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="2">• Two questions to be set from Unit-1with internal choice.
• Each question shall be for a maximum of 100 marks.
• Answer any one question</td><td>100 x 1 = 100 Marks</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H											M
CO2	H											M
CO3	H	M	M									M
CO4	H	M										M
CO5	H											M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC406L**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: IV**
Course title	**MACHINESHOP -I**					
Scheme and Credits	No. of Hours/Week					Total hours = 32
	L	T	P	SS	Credits	
	0	0	3	0	1	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To understand the different principles of Machines.
2. To understand the different operations of the machines.
3. To calculate the forces by measuring the forces from dynamometer.
4. To calculate the forces in milling operations & gear cutting.
5. To know the safety measures to be taken during the different operations.

COURSE CONTENT

Unit- 1

1. Welding processes – Models has to be prepared using TIG & MIG Welding , Gas welding and Forging operations **12 Hours**

Unit- 2

General Instructions: Process sheets and Inspection sheets are to be prepared for each model.

1. Detailed study of the following machine tools with regard to their construction, Operation and controls (i) Milling Machine (ii) Electro chemical Machining Setup (iii) Ultrasonic Machining setup (iv) Electric Discharge Machining setup.
2. Cutting gear teeth using Milling machine. –Spur Gear , Helical Gear and other gear cutting calculations and methods
3. Measurement of cutting forces in turning, milling and drilling using Dynamometer

Exercise should include selection of cutting parameters and cutting time estimate. **20 Hours**

Text Books:

1. HMT Production Technology, Tata McReaw-Hill 2002.
2. P N Rao, Manufacturing Technology, Volume – II, McGraw-Hill Education, 2018.

References Books:

1. Hajra Choudhury, Workshop Technology Volume-II, Media promoters & Publishers Pvt. Ltd., 2004.

2. Geoffrey Boothroyd," Fundamentals of Metal Machining and Machine Tools", Third Edition, CRC Press, 1988, ISBN 0824778529, 9780824778521.
3. R K Jain," Production Technology: Manufacturing Processes" 17th Edition, Khanna Publishers, 2012.

COURSE OUTCOMES: Students will

CO1: To apply the principles of theory in practical applications.
CO2: Apply the various operations required to prepare model using lather as per dimension.
CO3: Apply the various operations required to prepare model using shaping and milling machine.
CO4: Demonstrate the measurement of cutting forces using lathe tool dynamometer.
CO5: Selection of cutting parameters like cutting speed, feed and depth of cut and tooling for various operations.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Test I (Unit 1)	Test II (Unit 2)	Viva / Quiz	50 Marks
15 Marks	15Marks	20 Marks	
SEE = 100 Marks(To be Scaled down to 50 Marks)			
One Model from Unit 1	**One Model** from Unit 2	Viva-Voce	100 Marks
40 Marks	40Marks	20 Marks	

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	H		M							
CO2	H	M	H		M							
CO3	M	L			H							
CO4	M	M			M							
CO5	L	L			M							

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC407L**			**B. Tech (Mechanical Engineering)**		
Category	Professional Core					**Semester: IV**
Course title	**ENERGY LABORATORY**					
Scheme and Credits	No. of Hours/Week					Total hours = 32
	L	T	P	SS	Credits	
	0	0	3	0	1	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1 Conduct experiments on various heat transfer modes like conduction, convection and radiation
2 Acquire practical knowledge on working principles of heat exchanger, conduction, and convection and radiation heat transfer apparatus.
3 Learn about IC engines, lubricants and fuels
4 Understand the Various dynamometers used for testing IC engines
5 Acquires the knowledge of different engines & testing performance.

COURSE CONTENT

Unit- 1

1 Determination of thermal conductivity of metal rod
2 Determination of thermal conductivity of insulating powder
3 Determination of thermal conductivity of composite wall
4 Determination of heat transfer for free convection from a cylinder
5 Determination of heat transfer co-efficient for forced flow over tubes
6 Determination of heat transfer and effectiveness of a fin
7 Determination of emissivity of a surface
8 Determination of LMTD and effectiveness of
   A. Parallel flow heat exchanger
   B. Counter flow heat exchanger **11 Hours**

Unit- 2

1 Valve time diagram of 2 stroke C. I and S. I engines
2 Valve time diagram of 4stroke C. I and S. I engines
3 Performance test of 4 stroke petrol engine.
4 Performance test of 2 stroke petrol engine.
5 Performance test of 4 stroke diesel engine.
6 Performance test of 2 stroke diesel engine.
7 Morse test on a multi cylinder IC engine.
8 Performance test on variable compression engine.

9 Study the P-Θ, P-V and Heat release rate in a 4-stroke computer assisted diesel engine
10 Performance test on refrigerator and air conditioning **15 Hours**

Demonstration experiments

1 Determination of flash point and fire point of light, medium, and heavy oils.
2 Determination of calorific value of solid, liquid and gaseous fuel.
3 Determination of viscosity of oil using
   a. Saybolt viscometer.
   b. Redwood viscometer.
   c. Torsion viscometer.
   d. Use of plan meter.
4 Analysis of flue gases by using orsat apparatus.
5 To study the boiling and condensation phenomenon
6 Verification of stiffen – Boltzmann constant **06 Hours**

Text Books

1. An Introduction to energy conversion, Volume III – Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd. ISBN:9788122431896
3. Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co., 2nd Edition (2002). ISBN:9788122440225

References Books

1. Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company (1964) ISBN:0024096601
2. Fundamentals of Turbo machinery: William W Perg, John Wiley & Sons, Inc. 2008. ISBN:9780470124222

COURSE OUTCOMES: Students will

CO1: Understanding the fundamentals of conduction and convection and radiation through experiments
CO2: Minimize the heat loss by effective transfer.
CO3: Conduct experiments on fuels and lubricants
CO4: Analyze the performance of diesel and petrol engines used in automobiles
CO5: Evaluate the different engines performance & knows about recent development in engines

SCHEME OF EXAMINATION

CIE – 50 Marks			
Test I (Unit 1)	Test II (Unit 2)	Viva / Quiz	50 Marks
15 Marks	15Marks	20 Marks	
SEE = 100 Marks(To be Scaled down to 50 Marks)			
One Expt. from Unit 1	**One Expt.** from Unit 2	Viva-Voce	100 Marks
40 Marks	40Marks	20 Marks	

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L									M
CO2	M	H										H
CO3	H	H										M
CO4	H	M										H
CO5	H	H	L									M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21HSCP408</td><td colspan="4">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Humanity and Social Science & Management Courses</td><td>Semester: III</td></tr>
<tr><td>Course title</td><td colspan="6">CONSTITUTION OF INDIA & PROFESSIONAL ETHICS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 2 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Understand the provisions of fundamental right mentioned in “Constitution of India”.
2. Understand the various fundamental duties and their significance mentioned in “Constitution of India”.
3. Understand the structure of central and state executives of India.
4. Analyze the constitutional provision being made in India.
5. Analyze the various aspects of professional ethics.

COURSE CONTENT

UNIT-1

Meaning of Constitution and its Importance: Sources and features of Indian Constitution; Preamble, Fundamental rights under Part-III and Reasonable Restrictions

8 Hours

UNIT-2

Relevance of Directive principles of State Policy under Part-IV and Fundamental Duties & their significance under Part-IV-A **6 Hours**

UNIT-3

Union Executive – President, Prime Minister, Parliament & the Supreme Court of India. State Executive – Governors, Chief Minister, State Legislature and High Court- Federal structure

6 Hours

UNIT -4

Constitutional Provisions for Scheduled Castes & Tribes & Backward classes, Women & Children; Emergency Provisions; Electoral process; Amendment procedure; Latest Important Constitutional amendments. **7 Hours**

UNIT-5

Scope & aims of engineering ethics, Responsibility of Engineers; Impediments to responsibility; Honesty, Integrity and reliability, risks, safety & liability in engineering.

5 Hours

Text Books:

1. Durga Das Basu: "Introduction to the Constitution of India" (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. "Engineering Ethics" by Charles E.Haries, Michael. S.Pritchard and Micheal J.Robins Thompson Asia, 2003-08-05.
3. "An Introduction to Constitution of India" by M.V. Pylee, Vikas Publishing, 2002
4. "Engineering Ethics" by M. Govindrajan, S. Natarajan, V.S. Senthilkumar. Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.

eBooks / Online Resources

1. https://www.pediawikiblog.com/2015/04/vtu-be-constitution-of-india-and_92.html
2. https://www.vidyarthiplus.com/vp/Thread-Constitution-of-India-and-Professional-Ethics-Question-Papers-with-Answers
3. https://www.azdocuments.in/2020/02/constitution-of-india-professional.html
4. https://legislative.gov.in/sites/default/files/COI...pdf

MOOCs

1. https://legislative.gov.in/sites/default/files/COI...pdf
2. https://www.aryabharathipolytechnic.ac.in/syllabus/mechanicalengg/fourthsem/Professional%20Ethics%20&%20Indian%20%20Constitution.pdf
3. https://main.sci.gov.in/pdf/aorexam/Lecture%20regarding%20Professional%20ethics%20-%20Mr.%20R.Venkataramani,%20Senior%20Advocate-%20Supreme%20Court.pdf
4. https://soaneemrana.org/onewebmedia/Professional%20Ethics%20and%20Human%20Values%20by%20R.S%20NAAGARAZAN.pdf

COURSE OUTCOMES: Students will

CO1: Describe the provisions of fundamental right mentioned in "Constitution of India".
CO2: Summarize the various fundamental duties and their significance mentioned in "Constitution of India".
CO3: Discuss the structure of central and state executives of India.
CO4: Outline the constitutional provision being made in India.
CO5: Outline the various aspects of professional ethics.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">Unit 1,2 & 3</td><td colspan="2">Unit 4 &5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	M	H								L
CO2	M	M	M	H								L
CO3	M	H	H	H								L
CO4	H	H	H	H								L
CO5	H	H	H	H								L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21AE409</td><td colspan="4">B. Tech. (Common to all braches)</td></tr>
<tr><td>Category</td><td colspan="4">Ability Enhancement</td><td colspan="2">Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">BIOLOGY FOR ENGINEERS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="4">No. of Hours/Week</td><td></td><td rowspan="3">Total hours=32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>CIEMarks:50</td><td colspan="2">SEE Marks:50</td><td colspan="3">Total Max.Marks:100</td><td>Duration of SEE: 23 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. To familiarize the students with basic biological concepts and their engineering applications.
2. To enable the students with an understand bio design principles to create novel devices ad structures.
3. To provide the students an appropriation of how biological systems can be redesigned as substructure products for natural systems.
4. To motivate the students develop the incredibility vision of biological engineering.

COURSE CONTENT

UNIT-1

Principles of bioenergetics: Introduction, Laws of thermodynamics, Gibbs free energy, Relationship of standard free energy to enthalpy, entropy and equilibrium constant, high energy compounds, ATP as universal currency of free energy, oxidation-reduction reactions, electromotive force, half reactions, redox potential, relationship of standard redox potential and standard free energy change. Standard redox potential of biologically important half reactions..

05 Hours

UNIT-2

Nanotechnology: Mechanical methods (Grinding – high energy ball milling), Physical Methods (Vapor deposition - pulsed laser deposition), Chemical methods (Sol-gel process, Combustion route), Green synthesis (plant and microbial extracts). Applications of nanotechnology: Bioremediation, Biosensors, nano-materials in bone substitutes & dentistry, Food, cosmetic applications, textiles, paints, catalysis, drug delivery and its applications, Biochips- analytical devices. **05 Hours**

UNIT -3

Bioprocess Engineering: Typical structure and working mechanism of advanced bioreactor; Heat transfer and Mass transfer; Specialised bioreactors- design and their functions: airlift

bioreactor, tubular bioreactors, membrane bioreactors, tower bioreactors, fluidized bed reactor, packed bed reactors and photo bioreactors. Types of fermentation process-submerged fermentation, surface or solid state fermentation, batch fermentation, continuous fermentation, kinetics of fermentation process, bioprocess control and monitoring of physico-chemical conditions. Downstream proceeding: cell disruption, precipitation, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, Lyophilization and spray dry technology, crystallization, biosensors-construction and their applications. Application of bioprocess technology in food industry. **05 Hours**

UNIT -4

Bio designs, bioinspired materials and mechanisms: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics). Eye as a camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling – ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro). Human Blood substitutes-hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs). **06 Hours**

UNIT-5

Environmental Biotechnology: Introduction, renewable and non-renewable sources of energy; Design pollution free Environmental plans. Biomagnification, Bioindicators. Biomonitoring: Biosensors and biochips. Bioleaching of ores to retrieve scarce metals, Bio-mining. Strategies for the production of Bioethanol, Biobutanol and Biodiesel. Biogas production, methanol production from organic wastes, by-products of sugar industries. International policy and standards on biofuels. **06 Hours**

Reference:

1. Stuart Fox and Krista Rompolski (2022) Human Physiology, McGraw Hill Publication
2. Thyagarajan S, Selvamurgan N, Rajesh (2012) Biology for Engineers Tata McGraw Hill, New Delhi
3. Arthur T. Johnson (2011) Biology for Engineers, Taylor and Francis
4. Leslie Cromwell (2011) Biomedical Instrumentation, Prentice Hall
5. D. Floreano and C. Mattissi (2008) Bio Inspired Artificial Intelligence, MIT Press

Course Outcomes:

CO1. Elucidate the basic biological concepts via relevant industrial applications and case studies.

CO2. Evaluate the principles of design and development for exploring novel bioengineering projects.

CO3. Collaborate the concepts of biomimetic for specific requirements

CO4. Think critically towards exploring innovative bio based solutions for socially relevant problem. Ability to reduce and control air, water and noise pollution.

SCHEME OP EXAMINATION

CIE-50 Marks			
Unit I, II & III		Unit IV & V	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			

- There shall be 10 questions
- Two full questions to be set from each unit with internalchoice.
- ✓ Minimum number of sub questions : 2
- ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any Five questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H											M
CO2	M											M
CO3	H											M
CO4	H											M
CO5	M											M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21ME410</td><td colspan="3">B. Tech (Mechanical Engineering)</td><td colspan="2"></td></tr>
<tr><td>Category</td><td colspan="4">Ability Enhancement Course</td><td colspan="2">Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">GEOMETRIC DIMENSION & TOLERANCE</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 2 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Contrast between conventional and GD&T tolerance zones
2. To Understand the concepts of MMC, LMC and RFS.
3. To learn the basic Knowledge of Taylor's principle of gauging
4. To Create and Analyse the significance of selection of datum & datum features in Drawing
5. To Discuss about the application of Tolerance , Interpretation of Limits and its Applicability for some of Geometrical Drawings

COURSE CONTENT

Unit -1

Introduction: Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerance: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned & tolerance drawing; fits & allowances, advantages of GD&T **06 Hours**

Unit- 2

MMC, LMC & RFS: Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame **06 Hours**

Unit -3

Size Control Form: The Taylors principle; Gauging size limits. Rules, concepts, Characteristics, and Un-tolerance Dimensions: individual or related Datum's, Material Conditions; un-tolerance dimensions.

Datums: Datum features; oddly configured & curved surfaces as datum features; equalizing datum's; datum feature symbols; flexible parts; direct vs indirect tolerancing. MMC and its ramifications. Relations between individual features. Virtual Condition and Resultant condition Boundaries: Virtual

condition (MMC concept & a functional boundary). Effect of LMC; wall thickness calculation.

07 Hours

Unit -4

Datum Feature of Size Representation: Modes of datum feature representation; angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile; line element controls Run out: circular & total Location: concentricity; the return of symmetry; position **07 Hours**

Unit -5

Application: A Logical Approach to part Tolerancing Dimensioning and Tolerancing Schemes Steps for the Development of a Dimensional Inspection Plan Paper Gauging and Functional Gauging

06 Hours

Text Books

1. Fundamentals of Geometric Dimensioning and Tolerancing: Based on Asmey 2009 y Alex Krulikowski
2. Geometric Dimensioning & Tolerance (GD&T) REFERENCE GUIDE BOOK January 2016 by CAD Desk

References Books

1. James D Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, Inc
2. James D Meadows, "Measurement of Geometric Tolerances in Manufacturing" Marcel Dekker, Inc
3. P S Gill, "Geometric Dimensioning and Tolerancing", S K Kataria & sons, 2005-6

COURSE OUTCOMES: Students will

CO1: Understanding the fundamental Contrast between conventional and GD&T tolerance zones

CO2: To Understand the concepts of MMC, LMC and RFS.

CO3: To Create and Analyse the significance of selection of datum & datum features in Drawing

CO4: Analyze the Engineering problems in Drawing

CO5: Evaluate and implement the significance of selection of datum & datum features in Drawing

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any *Five* full questions choosing at least One full question from each unit.

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L									M
CO2	M	H										H
CO3	H	H										M
CO4	H	M										H
CO5	H	H	L									M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP – 2021

<table>
<tr><td>Course Code</td><td colspan="3">21UHV411</td><td colspan="3">B. Tech (Common to all Branches)</td></tr>
<tr><td>Category</td><td colspan="4">Universal Human Value Courses</td><td colspan="2">Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">UNIVERSAL HUMAN VALUES - II</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 16</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 2 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

This course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

COURSE CONTENT

UNIT-1

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations. **3 Hours**

UNIT-2

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health **3 Hours**

UNIT -3

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human

Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order **3 Hours**

UNIT-4

Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

3 Hours

UNIT-5

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession. **4 Hours**

Text Books:

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. The Teacher‟s Manual SAMPLE TEMPLATE 4 Teachers‟ Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991 15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press

21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

eBooks / Online Resources

1. Value Education websites, https://www.uhv.org.in/uhv-ii, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story
6. Gandhi A., Right Here Right Now, Cyclewala Productions

MOOCs

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://fdp-si.aicte-india.org/8dayUHV_download.php
3. https://www.youtube.com/watch?v=8ovkLRYXIjE
4. https://www.youtube.com/watch?v=OgdNx0X923I
5. https://www.youtube.com/watch?v=nGRcbRpvGoU
6. https://www.youtube.com/watch?v=sDxGXOgYEKM

COURSE OUTCOMES: Students will

CO1: The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
CO2: This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs
CO3: It is free from any dogma or value prescriptions.
CO4: It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation – the whole existence is the lab and every activity is a source of reflection.
CO5: This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1,2, & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any *Five* full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1						H		M				
CO2						M		H				
CO3						M		M				
CO4						H		M				
CO5						M		H				L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21BSBM412</td><td colspan="3">B. Tech. (Common to all braches except Civil Engineering branch)</td></tr>
<tr><td>Category</td><td colspan="5">Basic Science</td><td>Semester: IV</td></tr>
<tr><td>Course title</td><td colspan="6">BRIDGE MATHEMATICS-II (Lateral Entry students)</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours=50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

Course Objectives:

This course will enable all students to:

1. Develop a thorough knowledge and deep understanding of Laplace transforms, Laplace transform of derivatives, integrals and periodic function.
2. Study the reduction formulae for definite and indefinite integrals, Evaluation of these integrals with standard limits.
3. Be skilled in computations and applications Double and Triple integrals, Beta and Gamma functions.
4. Be able to solve the ordinary differential equations of first order and first degree and first order simultaneous differential equations.
5. Apply the concept of higher order differential equations.

COURSE CONTENT

Unit: I

Laplace Transforms: Definition and basic properties, Laplace transform of elementary functions and standard results, Laplace transform of derivatives and integrals, Laplace transform of periodic function Unit step functions, Inverse Laplace Transforms, Convolution theorem.

10hours

Unit: II

Integral Calculus-I: Standard reduction formulae for definite and indefinite integrals, Evaluation of these integrals with standard limits, problems, tracing of standard limits, problems, Tracing of standard curves in Cartesian form. **10hours**

Unit: III

Integral Calculus-II: Double and Triple integrals, evaluation by the change of order of integration, Beta and Gamma functions, Relation between beta and Gamma functions, applications. **10hours**

Unit: IV

Differential Equations-I: Solutions of ordinary differential equations of first order and first degree: Homogeneous forms, Linear and Bernoulli equations, Exact and reducible to exact equations, using standard integration factors. Solving the first order simultaneous differential equations. **10hours**

Unit: V

Differential Equations-II: Second and higher order differential equations, homogeneous linear equations with constant and variable co-efficient, problems .Non-homogeneous linear equations with constant and variable co-efficient, problems. Application of Laplace transform to solve linear ordinary differential equations of first and second order with constant co-efficient.

10hours

Text Books

1. G.B. Thomas and R. L. Finney, Calculus, Addison Wesley, 9th Ed., 1998.
2. E. Kreyszig," Advanced Engineering Mathematics" -Wiley, 2013.
3. P. V. ONeil, Advanced Engineering Mathematics, Pearson / Thomson.
4. D. S. Chandrashekaraiah, "Engineering Mathematics-II", Prism Books Pvt. Ltd. 7th Ed., 2014.

ReferenceBooks:

1. B.V. Ramana" Higher Engineering Mathematics" Tata Mc Graw - Hill, 2006
2. N. P. Baliand M. Goyal," A text book of Engineering Mathematics", Laxmi Publications, latest Ed.
3. H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics ",S .Chand Publishing, 1st Ed. ,2011.

eBooks / Online Resources

1. https://www.pdfdrive.com/bridges-in-mathematics-grade-2-student-book-e50123056.html
2. https://www.aicte-india.org/sites/default/files/final%20maths.pdf
3. https://easyengineering.net/engineering-mathematics-ii-by-ganesh/
4. https://www.mathlearningcenter.org/curriculum/free/practice-books

MOOCs

1. https://ncert.nic.in/textbook.php?lemh2=0-7
2. https://www.e-booksdirectory.com/listing.php?category=3
3. https://libguides.uml.edu/c.php?g=649032&p=4561998

COURSE OUTCOMES: Students are able to:

CO1: Use Laplace transform of elementary functions and standard results, Laplace transform of derivatives and integrals.
CO2: Computer education formulae for definite and indefinite integrals, Tracing of standard curves in Cartesian form.
CO3: Use Double and Triple integrals, Beta and Gamma functions appearing in engineering applications
CO4: Solve ordinary differential equations of first order and first degree and first order simultaneous differential equations.
CO5: Solve Second and higher order differential equations.

SCHEME OF EXAMINATION

CIE-50 Marks			
Unit 1,2 &3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE –20 x 5= 100Marks (To be Scaled down to50 Marks)			

- There shall be 10 questions
- Two full questions to be set from each unit with internalchoice.
- ✓ Minimum number of sub questions : 2
- ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any Five questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H										H
CO2	H	H										H
CO3	H	H										H
CO4	H	H										H
CO5	H	H										H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC501</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: V</td></tr>
<tr><td>Course title</td><td colspan="6">MACHINE DESIGN-I</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1 To understand the design procedure of machine components subjected to static loading.
2 To analyze the design procedure of components subjected cyclic and impact loading.
3 To understand the design procedure of power transmitting elements.
4 To understand the design procedure of permanent joints
5 To analyze the design procedure of temporary joints.

COURSE CONTENT

UNIT-1

Machine Design, Basic Procedure of Machine Design, Basic Requirements of Machine Elements, Design of Machine Elements, Use of Standards in Design, Aesthetic Considerations in Design, Ergonomic Considerations in Design, Factor of Safety, Theories of Failure. Design of Simple Machine Parts for static loading **10Hours**

UNIT-2

Stress Concentration, Fatigue Failure, Soderberg's, Goodman's and Gerber's Equations, Fatigue design under Combined stresses, Design of machine elements subjected to Impact loading. **10 Hours**

UNIT-3

Design of Solid and Hallow Shaft for combined Bending and Torsion for various Strength, Design of Crankshaft, Connecting Rod and, screw jack **10Hours**

UNIT-4

Design Mechanical joints: Cotter Joint, Knuckle Joint, Turnbuckle, Design of Riveted Joints: types of riveted joints, terminologies, failure of riveted joints, problems on longitudinal and circumferential riveted joints. **10Hours**

UNIT-5

Bolted Joints: load carrying capacity of bolts for static and dynamic loading, Eccentrically Loaded Bolted Joints. Welded Joints: Strength of Welds, Design of Axially Loaded Unsymmetrical Welded Joints with transverse and parallel fillet welds, eccentrically loaded welded joints, Design of Keys and Couplings. **10Hours**

TEXT BOOKS:

1 V B Bhandari : Design of Machine Elements, Tata McGraw Hill Publishing Company Ltd, 1998.
2 Joseph Edward Shigley & Charles, R Mischke : Mechanical Engineering Design‖. McGraw Hill International Edition, 2000.
3 J B K Das & P L Srinivasa Murthy : Design of Machine Elements, Sapna Book House, 2018.

BOOKS FOR REFERENCES:

1. Panday and Shah : Machine Design Design Data Books.
2. P C Sharma and D K Aggarwal : Machine Design, S K Kataria & Sons Publishers.
3. M F Spotts, et al. : Design of Machine Elements, Pearson Education. Inc, 2004 .
4. T Krisna Rao: Design of machine elements IK International Publishing house.
5. Prabhu T J : Fundamentals of Machine Design, Madras Book House, Chennai.

E BOOKS / ONLINE RESOURCES:

1. https://engineeringbookspdf.com/introduction-to-machine-design-pdf-free-download/5123/
2. https://www.academia.edu/44034692/A_Textbook_of_Machine_Design_by_R_S_KHURMI_AND_J_K_GUPTA
3. https://books.google.co.in/books?id=WWkoh3LAwdoC&printsec=frontcover&dq=e+books+on+Machine+design&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwjmy7bRy7f5AhXYyXMBHWKsCO4Q6AF6BAgLEAI
4. https://www.amazon.in/Machine-Design-Databook-2e-Bhandari-ebook/dp/B07TVYMD7Y

MOOCs:

1. https://www.my-mooc.com/en/mooc/machine-design-part-i/
2. https://pe.gatech.edu/courses/machine-design-part-1
3. https://www.mooc-list.com/course/machine-design-part-i-coursera
4. https://swayam.gov.in/NPTEL
5. https://www.udemy.com/topic/mechanical-engineering/

COURSE OUTCOMES:

The students at the end of the course will be able to:

CO1: Apply the design procedure and failure theories for safe design in the machine parts subjected to static loading.
CO2: Analyze the behavior of components subjected cyclic and impact loading.
CO3: Design the power transmitting elements for various loading conditions
CO4: Evaluate the load carrying capacity of temporary joints.
CO5: Evaluate the load carrying capacity of permanent joints.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1,UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any **Five** full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	L	L	M	M			M				M
CO2	L	M	M	M	M			M				M
CO3	M	M	H	H	M			H				H
CO4	L	H	M	H	H	L	M	H				H
CO5	L	H	M	H	H	L	M	H	L	L	L	H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21MEPC502</td><td colspan="4">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: V</td></tr>
<tr><td>Course title</td><td colspan="6">MANUFACTURING PROCESS - II</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
2. To introduce students to different machine tools to produce components having different shapes and sizes.
3. To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
4. To acquaint with the basic knowledge on fundamentals of metal forming processes
5. To study various metal forming processes.

COURSE CONTENT

UNIT –1

Introduction to Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Cutting tool materials and applications, Numerical problems.

Introduction to basic metal cutting machine tools: Lathe- Parts of lathe machine, accessories of lathe machine, and various operations carried out on lathe. Turret and Capstan lathe.

10 Hours

UNIT-2

Milling: Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling & down milling. Indexing: need of indexing, simple, compound & differential indexing. Drilling: Difference between drilling, boring & reaming, types of drilling machines. Boring operations & boring machines.

Shaping, Planning and Slotting machines: machining operations and operating parameters.

Grinding: Grinding operation, classification of grinding processes: cylindrical, surface & center less grinding.

10 Hours

UNIT-3

Introduction to tool wear: Tool wear mechanisms, tool life equations, effect of process parameters on tool life, machinability. Cutting fluid-types and applications, surface finish, effect of machining parameters on surface finish. Economics of machining process, choice of cutting speed and feed, tool life for minimum cost and production time. Numerical problems.

10 Hours

UNIT-4

Mechanical working of metals: Introduction to metal forming processes & classification of metal forming processes. Hot working & cold working of metals. Forging: Smith forging, drop forging & press forging. Forging Equipment, Defects in forging.
Rolling: Rolling process, Angle of bite, Types of rolling mills, Variables of rolling process, Rolling defects.
Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Various types of extrusion processes.

10 Hours

UNIT-5

Sheet Metal Operations: Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in drawing, Trimming, and Shearing.
Bending — types of bending dies, Bending force calculation, Embossing and coining.
Types of dies: Progressive, compound and combination dies.

10 Hours

TEXT BOOKS

1. Manufacturing Technology Vol I & II, P.N.Rao, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1998
2. Workshop Technology Vol. I and II, Chapman W. A.J., Arnold Publisher New Delhi, 1998
3. Elements of Manufacturing Technology Vol II, Hajra Choudhary, S. K. and Hajra Choudhary, A. K., Media Publishers, Bombay, 1988
4.

REFERENCE BOOKS

5. Sharma, P. C., A Text book of Production Engineering, New Delhi, 1995
6. Pandey and Sha, Modern Manufacturing Process, Prentice Hall, New Jersey.
7. HMT Production Technology, Tata McGraw Hill, 2001
8. Metal Forming Handbook, Schuler, Springer Verlag Publication

EBOOKS / ONLINE RESOURCESS

1. https://alison.com/course/introduction-manufacturing-processes

2. https://www.udemy.com/course/manufacturing-process-selection-and-design-for-manufacturing/

MOOCs

1. https://www.digimat.in/nptel/courses/video/112107145/L01.html

COURSE OUTCOMES:

The students at the end of the course will be able to

CO1: Explain the construction & specification of various machine tools.

CO2: Discuss different cutting tool materials, tool nomenclature & surface finish.

CO3: Apply mechanics of machining process to evaluate machining time.

CO4: Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.

CO5: Understand the concepts of different metal forming processes.

CO6: Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal Components.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1,UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any Five full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L			M						L
CO2	H	H	L			M						M
CO3	H	M			L	H			M	H		L
CO4	H	H			M	M		L		H		M
CO5	H	H				M	L				M	M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC503**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: V**
Course title	**FLUID MECHANICS AND MACHINERY**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To understand the fundamentals of fluid and their properties and basic concepts.
2. To understand the importance of kinematic flow.
3. To analyze the viscous flow through different sections and the importance of dimensional analysis.
4. To understand application of fluid in various hydraulic machines and turbines.
5. To analyze the fundamentals of steam turbines and centrifugal pumps.

COURSE CONTENT

UNIT –1

Fundamentals of fluid: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapor pressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc., pressure at a point in the static mass of fluid, variation of pressure. Pascal's law, absolute, gauge, atmospheric and vacuum pressures; pressure measurement by simple, differential manometers and mechanical gauges. Fluid Statics: Total pressure and center of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid, numerical problems. **10 Hours**

UNIT –2

Kinematic flows: introduction, types of flows, rate of flow of discharge, continuity equations and applications, equations of motions, Euler's equations motion, Bernoulli's equation from Euler's equation, applications of Bernoulli's equations: venturimeter, orifice meter, momentum equations, notches and weirs, numerical problems. **10 Hours**

UNIT –3

Viscous Flow: Introduction, flow of viscous fluid through circular pipe and two parallel plates and numerical. Flow through pipes, head loss due to friction- Darcy Weisbach equation, numerical problems.

Dimensional analysis- Methods of dimension analysis- Rayleigh's, Buckingham Л- theorem Similitude, numerical, Dimensionless quantities, physical quantities**,** numerical problems. . **10 Hours**

UNIT –4

Hydraulics machines and turbines: introduction, Classification of hydraulic turbines, heads and efficiencies, axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles- Draft tube- Specific speed, unit quantities, performance curves for turbines- Governing of turbines, Numerical Problems. **10 Hours**

UNIT –5

Centrifugal pumps: working principles heads and efficiencies, characteristic curves of centrifugal pump, cavitation in centrifugal pump. Reciprocating pump-working principle, classifications of reciprocating pump. Hydraulic press, accumulator, intensifier, ram, lift and crane. Numerical Problems. **10Hours**

TEXT BOOKS

1. Fluid Mechanics, Fundamentals & Applications, by Yunus A, Cenegel, John M,Cimbala, McGraw Hill Education; Third edition (1 July 2017) ISBN: 978-9339204655
2. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr. Bansal.R.K, Laxmi Publications; Tenth edition (2018) ISBN: 978-8131808153
3. Fundamentals of Fluid Mechanics by Munson, Young, Okiishi & Huebsch, John Wiley & Sons; 6th Revised edition edition (26 June 2009) ISBN: 978-0470398814

REFERENCE BOOKS

1. Fundamentals of Fluid Mechanics by F M White, McGraw Hill Publications. 5th Ed. ISBN:9780071215664
2. Hydraulics, Fluid Mechanics and Fluid Machines by S. Ramamrutham, Dhanpat Rai Publishing Company Private Limited-New Delhi; Ninth edition (2014). ISBN:9789384378271
3. Fox and McDonald′s Introduction to Fluid Mechanics by Philip J. Pritchard and John W. Mitchell, John Wiley & Sons; 9th edition (24 March 2015) ISBN: 978-1118912652

EBOOKS/ ONLINE RESOURCES

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Ed., Phi Learning, 2005
3. http://www.nptel.ac.in/syllabus/112106133/

MOOC's

1. https://www.edx.org/course/thermodynamics-iitbombayx-me209-1x
2. https://legacy.saylor.org/me103/Intro
3. https://www.coursera.org/course/introthermodynamics

COURSE OUTCOMES:

The students at the end of the course will be able to

CO1: Apply the principle of Bernoulli's equations and flow discharge systems.
CO2: Apply the friction- Darcy Weisbach equation and process systems of viscous flow.
CO3: Apply Euler's equation for turbo-machinery to analyze energy transfer in turbines and compressors.
CO4: Evaluate the performance parameters of pumps, compressors, turbines on a 1-D basis with the use of velocity triangles.
CO5: Estimate the data in design and development of Turbo-machines.

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SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1,UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L						L	M		H
CO2	H	H	M									H
CO3	H	H	H		H	H	L	M			H	H
CO4	H	M	M				L			M		H
CO5	M	M	L	L								H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC504**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: V**
Course title	**DYNAMICS OF MACHINES**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To understand the concepts of static forces in mechanisms.
2. To understand the concepts of dynamic forces distribution in various components of a mechanism and various functions of flywheel.
3. To understand the concepts and working of governors and gyroscope.
4. To understand the concepts of balancing of rotating and reciprocating masses of machines.
5. To study the concepts of various vibrations of mechanical systems.

COURSE CONTENT

UNIT –1

Static Force Analysis: Constraint and Applied Forces, Static Equilibrium, Equilibrium of Two-Force and Three-Force Members, Member with Two Forces and a Torque, Equilibrium of Four-Force Members, Force Convention, Free-Body Diagrams, Superposition, Principle of Virtual Work, Numerical Problems. **10Hours**

UNIT–2

Dynamic Force Analysis: Alembert's Principle, Equivalent Offset Inertia Force, Dynamic Analysis of Four-Link Mechanisms and Slider-Crank Mechanisms, Dynamically Equivalent System, Turning-Moment Diagrams, Fluctuation of Energy, Flywheels, Dimensions of Flywheel Rims, Punching Presses, Numerical Problems.

10Hours

UNIT–3

Governors: Types of Governors, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability, Effort and Power of a Governor, Controlling Force, Numerical Problems. Gyroscope : Angular Velocity, Angular Acceleration, Gyroscopic Torque (Couple), Gyroscopic Effect on Aero planes, and Naval Ships, Stability of Four and Two-Wheel Vehicles, Numerical Problems.

10Hours

UNIT–4

Balancing: Static Balancing, Dynamic Balancing, Balancing of Several rotating Masses in Different Planes, Balancing of Reciprocating Mass, Effects of Partial Balancing in

Locomotives, Balancing of V-Engines, Balancing of Radial Engines, Numerical Problems **10Hours**

UNIT –5

Vibrations, Types of Vibrations, Basic Features of Vibrating Systems, Degrees of Freedom, Free Longitudinal Vibrations, Damped Vibrations, Forced Vibrations, Forced-Damped Vibrations, of single degree freedom system Magnification Factor, Vibration Isolation and Transmissibility, Whirling of Shafts, Numerical Problems. **10Hours**

TEXTBOOKS:

1. Theory of Machines, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi,3rd Edition, 2009.
2. Theory of machines, by RK Bansal and Guptha

REFERENCES BOOKS:

1. Theory of Machines by J.E. Shiegley, Uicker, McGraw Publication.
2. Mechanisms and Dynamics of Machinery by Hamilton, H. Mabi, Charles F. Reinholtz., John Wiely Publishers.
3. Mechanical Vibration by P. Srinivasan.
4. Mechanical Vibration by Den Hertog J.P
5. Mechanical Vibration by G K Grover,
6. Mechanical Vibrations by SS Rao

COURSE OUT COMES:

The students at the end of the course will be able to

CO1: Analyze the static forces in various linkages of mechanisms.

CO2: Evaluate the dynamic force distribution in various components of a mechanism and energy storing capacity of flywheel.

CO3: Apply the concepts of governors for controlling the speed of the engine and gyroscopic effect.

CO4: Execute the balancing of unbalanced forces of rotating and reciprocating masses in machines.

CO5: Differentiate various types of vibrations and determine the parameters of vibrations,

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE – 50 Marks</td></tr>
<tr><td colspan="2">UNIT-1,UNIT-2 & UNIT-3</td><td colspan="2">UNIT-4 & UNIT-5</td></tr>
<tr><td>Test-1</td><td>AAT-1</td><td>Test-2</td><td>AAT-2</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L								M	H
CO2	H	H			L				L	M		H
CO3	M	M	L				M					M
CO4	H	M						M				M
CO5	M	L	L									M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC505L**			**B. Tech (Mechanical Engineering)**		
Category	Professional core				**Semester:V**	
Course title	**MANUFACTURING LABORATORY**					
Scheme and Credits	No. of Hours/Week					Total hours = 32
	L	T	P	SS	Credits	
	0	0	3	0	1	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100		Duration of SEE: 3 Hrs	
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To provide a basic knowledge on manufacturing Processes and selection of the process for production.
2. To provide a basic knowledge about the steps involved in casting process
3. To gain sound knowledge about requirements of moulding sand.
4. To provide basic knowledge about various components produced by sand moulds.
5. To give a hands on experience of basic foundry and forging practices.

General Instructions: Process sheets and Inspection sheets are to be prepared for each model.

PART-A

EXPERIMENTS ON MOLDING SANDS.

1. Determination of Grain fine ness number
2. Determination of Clay content test.
3. Effect of moisture content and clay contents on Permeability Number.
4. Effect of binder content on Bending and tensile strength under green and dry condition.
5. Determination of moulds hardness using dial gauge. 16Hrs

PART-B

EXPERIMENTS ON MOULDING

1. Creating mould cavity using Single piece pattern.
2. Creating Mould Cavity using Split pattern.
3. Creating mould cavity Using Geometrical shapes.
4. Observing microstructure of Cast ferrous and Non-ferrous metals.
5. Melting practice using Electrical furnace.

A small furnace in which demo of Al casting can be shown to the students. 16Hrs

TEXT BOOKS

1. Richard W Heine Carl R Loper "Principles of metal casting "Tata Mc- Graw hill Publications.

REFERENCE BOOKS

1. Steven R Schmid, Serope Kalpakjian, "Manufacturing Engineering and Technology", Pearson publication, 2014.
2. Geoffrey Boothroyd,"Fundamentals of Metal Machining and Machine Tools", Third Edition, CRC Press, 1988, ISBN 0824778529, 9780824778521.
3.R K Jain," Production Technology: Manufacturing Processes" 17th Edition, Khanna Publishers, 2012.

COURSE OUTCOMES

The students at the end of the course will be able to

CO1: Classify the manufacturing processes and identify the basic requirements for the casting process.

CO2: Explain the various properties of molding sands.

CO3: Describe the steps involved in sand casting process.

CO4: Summarize the terminology of casting.

CO5: describe the importance and applications of the melting and metal casting process.

SCHEME OF EXAMINATION

CIE (Lab – 50 Marks)	Marks	SEE (Lab – 100 Marks)	Marks
Performance of the student in the Lab every week	20	Write up	20
Test at the end of semester	20	Experiment 1(Part-A) = 30 marks Experiment 2(Part-B) = 30 marks	60
Viva voce	10	Viva voce	20
Total	**50**	**Total**	**100**

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	H	L			H					L
CO2	H	M	M									L
CO3	H	H	L	L		L		M			M	L
CO4	M	H	L						L			L
CO5	M	M	M	L	M					L		L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC506L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: V</td></tr>
<tr><td>Course title</td><td colspan="6">FUID MECHANICS LABORATORY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="2">Total Max. Marks: 100</td><td colspan="2">Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Understanding calibration of flow measuring devices.
2. Conduct, Analyze, Interpret and present measurement data from measuring equipment's.
3. Understand the major and minor losses in pipe.
4. Evaluate the performance parameters of different pumps.
5. Evaluate the performance parameters of different Turbines.

COURSE CONTENTS

PART A

1. Calibration of pressure gauge.
2. Calibration of V notch.
3. Determination of coefficient of vertical and horizontal orifices.
4. Calibration of venturimeter.
5. Losses in pipes
6. Impact of jet on vanes.
7. Testing of hydraulic ram. 14Hrs

PART B

1. Performance test on centrifugal pump.
2. Performance test on reciprocating pump.
3. Performance test on Pelton turbine.
4. Performance test on Francis turbine.
5. Performance test on Kaplan turbine.
6. Performance test on air blower.
7. Performance test on single and two stage compressor. 14Hrs

Demonstration experiments

1. Pressure distribution on symmetrical and cambered aero-foil
2. Pressure distribution on cylinder and Sphere

3. Velocity measurement using Pitot static tube.
4. Coefficient of Lift and Drag on streamlined and bluff bodies
5. Flow Visualization on aerofoil using wind tunnel. 08Hrs

TEXT BOOKS

1.An Introduction to energy conversion, Volume III – Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd. ISBN:9788122431896
2.Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co., 2nd Edition (2002). ISBN:9788122440225

REFERENCES BOOKS

1.Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company (1964) ISBN:0024096601

2.Fundamentals of Turbo machinery: William W Perg, John Wiley & Sons, Inc. 2008. ISBN:9780470124222

COURSE OUTCOMES

Upon completion of this course, student will be able to:

CO1: Understand the concept of fluid and measure the static forces of the fluids.
CO2: Understand and apply the concepts of pressure distribution and buoyancy.
CO3: Understand and apply Newton's law of motion applied to fluid element & pressure measuring devices.
CO4: Understand the concepts of laminar and turbulent flow.
CO5: Understand the concept of dimensional analysis, and usage of dimensional numbers.

SCHEME OF EXAMINATION

CIE (Lab – 50 Marks)	Marks	SEE (Lab – 100 Marks)	Marks
Performance of the student in the Lab every week	20	Write up	20
Test at the end of semester	20	Experiment 1(Part-A) = 30 marks Experiment 2(Part-B) = 30 marks	60
Viva voce	10	Viva voce	20
Total	**50**	**Total**	**100**

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L			L				L		M
CO2	M	H		H								M
CO3	M	H	L					L				H
CO4	L	M			M		M		H			L
CO5	M	L	L			L					M	M

L – Low, M – Medium, H – High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEAE507L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Ability Enhancement Course</td><td>Semester: V</td></tr>
<tr><td>Course title</td><td colspan="6">ENGINEERING ANALYSIS USING MATLAB</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>2</td><td>3</td><td>0</td><td>2</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Identify the ensure inbuilt in MATLAB.
2. Understand the use of commands in developing algorithms.
3. Apply algorithms for solving problems.
4. Analysis of different methods of developing algorithms for specific application.
5. Integrations of inbuilt functions and use defined function to solve practical problems.

COURSE CONTENT

PART – A

Introduction to MATLAB – As Programming Language

1. Introduction to Simple Calculations with MATLAB

a) Data Types (Numeric, String) and their conversion

b) Scalar Quantities and Variables

c) Mathematical Functions

- Arithmetic Functions +,-,/,*
- Bitwise Operators, Relational Operators, Logical Operators
- Trigonometric and inverse trigonometric Functions

d) Vectors and Matrices

- Matrix Multiplication (scalar and Matrix Multiplications, division)
- Sum, Transpose, Diagonal and Inverse of a Matrix.
- LU decomposition, QR Factorization

2. Introduction to Scripts files and functions
3. Flow Control
4. 2D and 3D plots (including contour plots)

a)Loops (For Loop, While Loop, Do while loop)

b) Conditional Statements if else

c) Switch statement

d) Vectorization

5. Polynomials

a) Inbuilt functions - root, polyfit, polyval,etc,.

b) Root Finding by Bisection, Newton-Raphson Method, Secant Methods

6.Numerical Integration Methods

a) Trapezoidal Rule
b) Simpsons rules (1/ 3rd and 3/ 8th Rule)
7. Solving ODE using - Runge-Kutta Methods
8. Introduction to Laplace Transform 25Hrs

PART-B

Application of MATLAB to Mechanical Engineering

1. Engineering Mechanics
   - Statics- Forces in Structures (Trusses, Friction etc)
   - Dynamics
     - Path of Projectile
     - Moving Rigid bodies
2. Fluid Mechanics
   - Statics - Pascal Law
   - Dynamics
     - Applications of Bernoulli principle
     - Stream function and Potential functions
3. Mechanical Vibrations
   - Free Vibrations with and without damping
   - Forced Vibrations with damping
4. Strength of Materials
   - Plot Shear Force, Bending moment and Deflection diagrams for different beams
     - Cantilever
     - Simply supported beam
5. Finite Element Method
   - Heat transfer through Fin
   - Stress Analysis for Bars, Truss and Beams

6. Kinematics and Kinetics of Four Bar Mechanism 25Hrs

REFERENCES:

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Rudra Pratap, Oxford University Press, 2002, ISBN 0195150147, 9780195150148
2. An Engineer's Guide to MATLAB, Edward B. Magrab, MD Shapour Azarm, MD Balakumar Balachandran, MD James H. Duncan, MD Keith E. Herold Fischell, MD Gregory C. Walsh Leica
3. Essential MATLAB for Engineers and Scientists by Brian D. Hahn and Daniel T. Valentine
4. Matlab an introduction with applications – Amos Gilat, Wiley, 2011
5. Danilo. 6.094 Introduction to MATLAB, January IAP 2010. (Massachusetts Institute of Technology: MIT Open Course Ware), http://ocw.mit.edu (Accessed 31 May, 2012). License: Creative Commons BY-NC-SA
6.Numerical Methods in MATLAB, Center for Interdisciplinary Research and Consulting, Department of Mathematics and Statistics University of Maryland, Baltimore County.
7. An Introduction to Programming and Numerical Methods in MATLAB by S.R. Otto and J.P. Denier
8. APPLIED NUMERICAL METHODS USING MATLAB, Won Young Yang, Wenwu Cao, John Wiley & Sons, Publications

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Utilize MATLAB software to simulate practical problems
CO2: Apply algorithms for problem solving.
CO3: Develop solutions to mathematical models applied to practical problems.
CO4: Validation of different algorithms.
CO5: Create algorithms for defining and analysis of mechanical systems.

SCHEME OF EXAMINATION

CIE (Lab – 50 Marks)	Marks	SEE (Lab – 100 Marks)	Marks
Performance of the student in the Lab every week	20	Program write -up	20
Test at the end of semester	20	Program Execution 1(Part-A) = 30 marks Program Execution 2(Part-B) = 30 marks	60
Viva voce	10	Viva voce	20
Total	**50**	**Total**	**100**

Note: * SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L	L			H					H
CO2	H	M	L		H							M
CO3	H	M	H	L				L		M		M
CO4	H	H	H			M			L		L	M
CO5	H	H	M	L								L

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering ,UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21CVHS508</td><td colspan="3">B. Tech (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="4">Humanity and Social Science & Management Courses,</td><td colspan="2">Semester: V</td></tr>
<tr><td>Course title</td><td colspan="6">ENVIRONMNETAL SCIENCE</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total 25Hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>2</td><td>0</td><td>--</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 2 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE LEARNING OBJECTIVES:

1. Gives better understanding about environment and their importance.
2. Gives information about renewable and non-renewable resources.
3. Helps in understanding the ecosystem
4. Helps to understand the consequences of environmental pollution.
5. To understand about disaster management

COURSE CONTENT

UNIT - 1

The multidisciplinary nature of Environment studies : Definition, Scope and importance of environment, Need for public awareness

5 Hrs

UNIT - 2

Natural Resources: Renewable and Non-renewable resources, Natural Resources and Associated problems

a. Forest resources: Use and over exploitation, Deforestation, Case studies, Timber Extraction, Forest management.
b. Water resources: Use and over utilization of surface and ground water, floods, Drought. Conflicts over water, Dams, Benefits and problems.
c. Energy resources: Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources. Case studies.
d. Role of an individual in conservation of natural resources.

5 Hrs

UNIT - 3

Fundamentals of Ecology: Introduction and Scope: Concept of an ecosystem. Structure and function of an ecosystem. -Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

5 Hrs

UNIT- 4

Types Of Ecosystem: Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

5 Hrs

UNIT - 5

Environmental Pollution**:** Definition, Causes, effects, and control measures of: Air pollution, Water pollution, Soil pollution, Noise pollutionSold waste management; Causes, effects and control measures of urban and industrial wastes, Wasteland reclamation.Role of an individual in prevention of pollution. Pollution case studiesDisaster management: floods, earthquake, cyclone, droughts, tsunami and landslides.

5 Hrs

REFERENCE:

1. J P Sharma, Environmental Studies 3rd edition. University Science Press, New Delhi,2009
2. R . Rajagopalan - Environmental Studies 2nd edition. Oxford University Press, 2011.
3. Aloka Dehi, Environmental Science and Engineering, 2nd edition , Universities Press,2012.
4. Erach Bharucha, Environmental Studies 2nd edition, Universities Press, 2013

COURSE OUTCOMES:

CO1. Ability to reduce and control air, water and noise pollution.
CO2. Ability to understand individual ecosystem
CO3. Ability to manage natural disasters.
CO4. Ability to ascertain natural resources and their scarcity,
CO5. Causes, effects and control measures of urban and industrial wastes, Wasteland

SCHEME OF EXAMINATION:

CIE – 50 Marks	Test – 1, (Unit 1,2 & 3) – 20 Marks	Quiz – I, 5 Marks	25 Marks	Total: 50 Marks
	Test – II, (Unit IV & V) – 20 Marks	Quiz – II, 5 Marks	25 Marks	
SEE – 50 Marks	Q1 &Q2 from Unit – 1, shall have internal choice		20 Marks	Total: 100 Marks
	Q3 &Q4 from Unit – 2, shall have internal choice		20 Marks	
	Q5 &Q6 from Unit – 3, shall have internal choice		20 Marks	
	Q7 &Q8 from Unit – 4, shall have internal choice		20 Marks	
	Q9 &Q10 from Unit – 5, shall have internal choice		20 Marks	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L	L			H					H
CO2	H	M	L		H							M
CO3	H	M	H	L				L		M		M
CO4	H	H	H			M			L		L	M
CO5	H	H	M	L								L

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEIN509**			**B. Tech (Common to All Branches)**		
Category	Internship					**Semester: V**
Course title	**SUMMER INTERNSHIP-II**					
Scheme and Credits	No. of Hours/Week					Total 8Hrs
	L	T	P	SS	Credits	
	0	2	6	--	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 2 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students:

1. To facilitate an understanding of the issues that confronts the vulnerable / marginalized sections of the society.
2. To initiate team processes with the student groups for societal change.
3. To provide students an opportunity to familiarize themselves with urban / rural community they live in.
4. To enable students to engage in the development of the community.
5. To plan activities based on the focused groups.\
6. To know the ways of transforming the society through systematic programme implementation.
7. Explore career alternatives prior to graduation.
8. Integrate theory and practice.
9. Assess interests and abilities in their field of study.
10. Learn to appreciate work and its function towards future .
11. Develop work habits and attitudes necessary for job success.
12. Develop communication, interpersonal and other critical skills in the future job.
13. Build a record of work experience.
14. Acquire employment contacts leading directly to a full-time job following graduation from college.
15. Acquire additional skills required for world of work.

COURSE CONTENT

GUIDELINES:

Internship is a Programme in which during the intervening period in V semesters Innovation / Entrepreneurship/ Societal based Internship.

1. To be carried out during the vacation after the IV semester and before the commencement of the V semester for duration of 4 to 8 weeks students are permitted

to take Summer Internship-II at Central Excellences/Studies established in the same institute and / or out of the institute including companies.

2. A University examination shall be conducted during the V semester and the prescribed credit shall be included in the V semester.

3. During the intervening period of IV and V semesters, students shall be ready for industrial experience. Therefore, they shall choose to undergo Internship-II involving Innovation Entrepreneurship/Societal related activities.

4. Students may choose to work on innovation or entrepreneurial activities or both resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

5. In case students want to undergo summer internship-II at his/her family business, he /she shall be permitted provided; a declaration by a parent is submitted directly to the principal of the institution.

6. With the consent of the internship guide and Principal of the institution, students shall be allowed to carry out the internship at their hometown (within and outside the state), provided favourable facilities are available.

7. In case, students wish to take both Innovation, and Entrepreneurship internship, they shall be permitted to take up both. Summer Internship - II period, in such cases, can extend marginally by few days, provided it will not interfere with the academic calendar of higher semester

COURSE OUTCOMES: Students will

CO1: Apply appropriate workplace behaviors in a professional setting.
CO2: Demonstrate content knowledge appropriate to job assignment.
CO3: Exhibit evidence of increased content knowledge gained through practical experience.
CO4: Describe the nature and function of the organization in which the internship experience takes place.
CO5: Explain how the internship placement site fits into a broader career field.
CO6: Evaluate the internship experience in terms of personal, educational and career needs.

SCHEME OF EXAMINATION

Each faculty member is to be assigned 2 to3 batches of students each batch may have 4 or 5 students. The assessment is to be conducted for 50 marks for CIE and 100 Marks for SEE and reduced to 50 marks to be incorporated in the result. Internship Seminars has to be presented once in 15 days with the concern of the respective Guide/s, Coordinator and Chairperson about the progress of the Summer Internship -II.

For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Topic of internship	10%	50
2.	Objectives of internship	10%	
3.	Specific skills acquired	20%	
4.	Documentation	40%	
5.	Presentation	20%	
Total		100%	

Each student is required to maintain an individual logbook, where he/she is supposed to record day to day activities. The Internship-II is assessed on an individual basis, thus allowing for individual members within groups to be assessed this way. The assessment will take into consideration the individual student's involvement in the assigned work.

Rubrics for SEE:

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Topic of internship	10%	100 To be reduced to 50
2.	Objectives of internship	10%	
3.	Specific skills acquired (Write up about in Internship)	20%	
4.	Presentation	40%	
5.	Viva-Voce	20%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H									H
CO2	H	H	M									M
CO3	H	H	M									M
CO4	H	H	M									H
CO5	H	H	H									H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21MEPC601</td><td colspan="3">B. Tech (Mechanical Engineering)</td><td colspan="2"></td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td colspan="2">Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="7">MECHANICAL MEASUREMENTS AND METROLOGY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td><td></td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td><td></td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td colspan="2">Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. Understand what are generalized measurement system, and its three stages.
2. Demonstrate the terminologies of transducers, intermediate modifying devices and terminating devices.
3. Analyze the measurement of Strain, Force, Torque and Power.
4. Evaluate the pressure flow and temperature measurement.
5. Emphasize the measurement of linear measurements.

COURSE CONTENT

UNIT-1

Measurement & measurement systems: Introduction, Definition, Basic requirements, Methods of measurement. Generalized measurement system, fundamental & derived units, Standards of measurements, Role of Measurement in Industry. Transducers: Classification of transducers, Transfer efficiency, Variable-resistance, Inductance and Capacitive transducers, LVDT, Piezoelectric transducer, Electronic transducer, Photo-Voltaic, emissive & conductive transducers. Relative merits & demerits of Mechanical and Electrical transducers.

10 Hours

UNIT – 2

Intermediate modifying devices: Mechanical devices, Simple current sensitive circuit, Ballast circuit, Voltage dividing & balancing circuit, Resistance & Impedance bridges.

Terminating devices**:** Different types of meter indicators, VTVM, CRO, Oscillographs, X-Y plotter.

10 Hours

UNIT – 3

Measurement of strain: Types of strain gauges, Selection and installation, Gauge factor, Temperature Compensation, Configuration for measuring tensile and bending strains & Stresses, Discussion of application. Measurement of force, torque & power: Proving Ring, Load Cell, Absorption &Transmission dynamometers, Discussion of application.

10 Hours

UNIT – 4

Measurement of pressure, flow & temperature: MC leod gauge, Pirani gauge, Diaphragm and Bellows, Bourdon pressure gauge. Rota meter, Magnetic flow meter, Turbine meter, Rotating disc meter. Bimetallic thermometers, Resistance thermometer, Thermistors, Thermocouples, Thermopiles, Pyrometers, Discussion of application.

10 Hours

UNIT – 5

Linear measurements: Gauge Blocks, Dial gauge, Bevel protractors, Sine bar, Planimeter, Tool room microscope, Profile projector, use of Auto collimator, Straightness testing. Principle of Interferometry-optical flats, Measurement of surface roughness, Discussion of application.

10 Hours

TEXT BOOKS:

1. Mechanical Measurement-Beckwith & Buck, Roy. D. Marangoni, John. H. Lienhard.
2. Mechanical Measurements- Sirohi & Radhakrishna
3. Mechanical Measurements- RK Jain
4. Engineering Metrology- RK Jain

REFERENCE BOOKS:

1. Experimental methods for engineers - J. P. Hollman
2. Engineering Measurements -Deoblin
3. Engineering Measurements –Collet & Hope.
4. Engineering Metrology – IC Guptha
5. Principles of Measurement Systems – John P.Bentley

EBOOKS / ONLINE RESOURCES

1. Engineering Metrology And Measurements N.V.Raghavendra, L.Krishnamurthy
2. A Textbook of Measurements & Metrology, R.K.Rajput

MOOCs

1. Mechanical Measurements and Metrology, IIT Madras
2. Principles of Mechanical Measurements, IIT Madras

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Explain the generalized Measurement system & role of measurements.

CO2: Discuss the three stages of measurements system.

CO3: Illustrate the measurements of Strain, Force, Torque, & Power.

CO4: Illustrate the measurement of Pressure, Flow & Temperature.

CO5: Analyze the necessity of linear measurements.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any **Five** full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M			M	M	L				L		M
CO2	H	L		H	H	H		H				M
CO3	L			M	L	L			L			M
CO4	H		L	L	H		M					M
CO5	M			M	H	L				L	L	M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21MEPC602</td><td colspan="4">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">MACHINE DESIGN II</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1 To understand the design procedure of energy storing and absorbing components.
2 To highlights the design procedure for machine parts subjected to frictional forces and power transmission by friction.
3 To understand the design procedure of supporting and friction reducing components of rotating shafts.
4 To understand the design procedure of power transmitting components for short center distance parallel shafts.
5 To demonstrate the design procedure of power transmitting components for short center distance perpendicular and intersecting shafts.

COURSE CONTENT

UNIT –1

Springs, Types of Springs, Stress and Deflection Equations, Design against Fluctuating Load, Concentric Springs, Helical Torsion Springs, Spiral Springs, Leaf Spring, Belleville Spring. Numerical problems.

10 Hours

UNIT-2

Brakes, Energy Equations, Block Brake with Short and Long Shoes, Pivoted Block Brake with Long Shoe, Internal Expanding Brake, Band Brakes, Disk Brakes, and Thermal Considerations. Design of Clutches: friction materials. Disc, Cone and Centrifugal Clutch, Torque Transmitted by clutches, Numerical problems.

10Hours

UNIT-3

Bearings, Sliding Contact Bearing, Petroff's Equation, Hydrostatic Step Bearing, Bearing Design, Bearing Failure, Causes and Remedies, Rolling-contact Bearings, Bearing-types, Equivalent Bearing Load, Load-Life Relationship. Numerical problems.

10Hours

UNIT-4

Design of Spur and Helical Gears: Terminology, Force Analysis, Gear Tooth Failures, Selection of Gear Material, Number of Teeth, Force Analysis, Beam Strength of Helical Gears, Effective Load on Gear Tooth, Wear Strength of Spur and Helical Gears. Numerical problems. **10Hours**

UNIT-5

Design of Bevel Gears, Worm and Worm Wheel: Terminology, Force Analysis, Beam Strength, Effective Load on Gear Tooth, Wear Strength of Bevel Gears, Worm and Worm Wheel, Numerical problems.

10 Hours

TEXT BOOKS:

1. V B Bhandari : Design of Machine Elements, Tata McGraw Hill Publishing Company Ltd, 1998.
2. P C Sharma and D K Aggarwal : Machine Design, S K Kataria & Sons Publishers.
3. J B K Das & P L Srinivasa Murthy : Design of Machine Elements, Sapna Book House, 2018.
4. Joseph Edward Shigley & Charles, R. Mischke : Mechanical Engineering Design‖. McGraw Hill International Edition, 2000.

REFERENCES BOOKS:

1. Panday and Shah : Machine Design Data Books.
2. Prabhu T J : Fundamentals of Machine Design, Madras Book House, Chennai.
3. M F Spotts, et al. : Design of Machine Elements, Pearson Education. Inc, 2004.
4. T Krisna Rao: Design of machine elements IK International Publishing house Pvt. LTd.

EBOOKS / ONLINE RESOURCES

1. https://www.academia.edu/44034692/A_Textbook_of_Machine_Design_by_R_S_KHURMI_AND_J_K_GUPTA
2. https://books.google.co.in/books?id=WWkoh3LAwdoC&printsec=frontcover&dq=e+books+on+Machine+design&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwjmy7bRy7f5AhXYyXMBHWKsCO4Q6AF6BAgLEAI
3. https://www.amazon.in/Machine-Design-Databook-2e-Bhandari-ebook/dp/B07TVYMD7Y
4. https://easyengineering.net/machinedesignbooks/
5. http://www.engineering108.com/pages/Mechanical_Engineering/Machine_Design/Machine_design_ebooks-free-download.html
6. https://www.machinedesign.com/learning-resources/ebooks
7. http://www.freebookcentre.net/Mechanical/Machine-Design-Books.html
8. https://engineeringbookspdf.com/category/mechanical-engineering-books/machine-design-books/
9. https://www.amazon.in/Machine-Design-U-C-Jindal-ebook/dp/B00GO552JY

MOOCs

1. https://www.my-mooc.com/en/mooc/machine-design-part-i/
2. https://pe.gatech.edu/courses/machine-design-part-1
3. https://www.mooc-list.com/course/machine-design-part-i-coursera
4. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
5. https://www.udemy.com/topic/mechanical-engineering/
6. https://swayam.gov.in/NPTEL

COURSE OUT COMES:

The students at the end of the course will be able to:

CO1: Apply the design procedure of energy storing and absorbing components for various applications.

CO2: Analyze the use of frictional forces for retarding the motion and power transmission.

CO3: Analyze the supporting and friction reducing components of rotating shafts to increase the efficiency.

CO4: Evaluate the parameters of power transmitting components in parallel shafts.

CO5: Evaluate the parameters of power transmitting components in perpendicular and intersecting shafts.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	L	L						M			L
CO2	L	M	M									L
CO3	M	M	H							H		M
CO4	L	H	M		M			L		H		M
CO5	L	H	M	M			L				M	M

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPC603**		**B. Tech (Mechanical Engineering)**			
Category	Professional Core					**Semester: VI**
Course title	**FINITE ELEMENT METHODS**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To study the applicability of FEM to a range of Engineering Problems.
3 Study about truss, beam, plane triangular and quadrilateral elements.
4. Apply to static and dynamic analysis
5. To acquaint with applications of numerical techniques for solving problems.

COURSE CONTENT

UNIT –1

Equations of elasticity – Introduction to Stresses, State of Stress at a point, Differential Equations of Equilibrium, for two and three dimensional cases, Plane stress, Plane strain and Axisymmetric cases

Introduction to Finite Element Analysis: Engineering Analysis, Basic Concept and steps, General and Engineering applications of the FEA, Advantages and disadvantages of FEA, Governing Equations, Weighted residual techniques, Least squares, Galerkin , Rayleigh Ritz methods Variation formulations, Boundary Value problems., Types of elements based on Geometry, bandwidth. Basic Equations and Potential Energy Functional, Convergence requirements, coordinate systems, patch test, Sources of FEA errors **10Hours**

UNIT – 2

Derivations and solutions for 1-D Bar Element: Types, Quadratic element, 2 Noded elements: Strain Displacement matrix, Shape functions and its properties, Strain matrix, Element equations, Types of forces, Assembly Procedure Displacement Methods: Definition and derivation of Stiffness matrix, Problems on various boundary conditions, Homogeneous and Non Homogeneous. Properties of a stiffness matrix. Quadratic element: Strain– Displacement matrix, element stiffness matrix, Element force vector. Temperature effects. Numerical Problems. **10 Hours**

UNIT – 3

Jacobian matrix, Strain displacement matrix, Element stiffness, force term, Derivations and solutions for three noded triangular element, four noded rectangular element, four noded quadrilateral element, eight noded quadrilateral

element and CST elements, Shape functions for Higher Order Elements. Numerical Problems. **10Hours**

UNIT –4

Structural analysis through FEM for Beams and Trusses: Beams: 2-Noded beam element, Finite element formulation, load vector-point load, UDL, shear force and bending moment, Deflection equation, shape functions and stiffness matrixes. Trusses Equation of truss, stiffness matrix derivation, and assumptions, Numerical problems **10 Hours**

UNIT – 5

FEM for Dynamic analysis, system of springs, Formulation for point mass and distributed masses, Consistent element mass matrix of one dimensional bar element, truss element, quadrilateral element, beam element. Lumped mass matrix, Evaluation of Eigen values and Eigen vectors, Applications to bars, stepped bars, and beams, problems Introduction to commercial software's. **10 Hours**

TEXT BOOKS

1. Chandrupatla T. R., "Introduction to Finite Elements in Engineering"- 4 th Edition, Pearson, ISBN-13: 978-0132162746

2. Lakshmi Narayana H. V.,"Finite Elements Analysis"– Procedures in Engineering, Universities Press, ISBN-13: 978-83714764

REFERENCE BOOKS:

1. P.Seshu, "Textbook of Finite Element Analysis" -PHI, ISBN : 978-81-203-2315-5
2. .N.Reddy,"Finite Element Method"-McGraw-Hill International Edition. 3rd Ed, ISBN: 9780070607415
3. Cook R. D., et al., "Concepts and Application of Finite Element Method" John Wiley & Sons INC 4th edition, ISBN-13: 978-0471356059

COURSE OUTCOMES:

The students at the end of the course will be able to:

CO1: Students will understand the FEM formulation and its application to engineering problems

CO2: Develop the finite element equations to model engineering problems governed

CO3: Apply the basic finite element formulation techniques to solve engineering problems.

CO4: Improve the computational efficiency by reducing the different types of errors

CO5: Use commercial FEA software, to solve problems related to mechanical engineering.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any **Five** full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	M						L	M		H
CO2	H	H	M									M
CO3	M	M	L		H	H	L	M			H	M
CO4	M	H	H				L			M		L
CO5	M	M	L	L								L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE604A</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-1</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">CONTROL ENGINEERING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To learn mathematical modelling of mechanical systems.
2. To learn a basic understanding of feedback control systems theory.
3. To learn the ability to perform analysis and design of linear feedback control systems.
4. To learn physical & mathematical skills to solve linear control problems.
5. Draw figures, graphs and block diagrams to summarize, solve &present control engineering problems.

COURSE CONTENT

UNIT –1

Mathematical Model of Control System: Control System, Examples of Control Systems, Mathematical Models of Control System, Mechanical Translational Systems, Mechanical Rotational Systems, Electrical System, Transfer Function of Armature Controlled DC Motor, Transfer Function of Field Controlled DC Motor, Electrical Analogous of Mechanical Translational Systems, Electrical Analogous of Mechanical Rotational Systems, Block Diagrams, Block Diagrams Reduction using MATLAB, Signal Flow Graph, Numerical problems

10 Hours

UNIT –2

Time Response Analysis: Time Response, Test Signal, Impulse Response, Order of a System, Review of Partial Fraction Expansion, Response of First Order System for Unit Step Input, Second Order System, Response of Un-damped Second Order System for Unit Step Input, Response of Under-damped Second Order System for Unit Step Input, Response of Critically Damped Second Order System for Unit Step Input, Response of Over Damped Second Order System for Unit Step input, Time Domain Specifications, Type Number of Control System, Steady State Error, Static Error Constant, Steady State Error when the Input is Unit Step Signal, Steady State Error when the Input is Unit Ramp Signal, Steady State Error when the Input is Unit Parabolic Signal, Generalized Error Coefficients, Evaluation of Generalized Error Coefficients, Correlation between Static and Dynamic Error Coefficients, Time Response Analysis using MATLAB, Numerical problems. **10Hours**

UNIT –3

Frequency Analysis**:** Sinusoidal Transfer Function and Frequency Response, Frequency Domain Specifications, Frequency Domain Specifications of Second Order System,

Correlation between Time and Frequency Response, Frequency Response Plots, Bode Plot, Polar Plots, Nichols Plot, Loop Response from Open Loop Response, M and N Circles, Nichols Chart, Frequency Response Analysis Using MATLAB, Numerical problems **10 Hours**

UNIT-4

Concepts of Stability and Root Locus: Impulse Response and Stability, Location of Poles on S-Plane for Stability, Routh Hurwitz Criterion, Mathematical Preliminaries for Nyquist Stability Criterion, Nyquist Stability Criterion, Relative Stability, Gain Margin and, Root Locus, Nyquist and Root Locus Plots using MATLAB, Numerical problems. **10 Hours**

UNIT –5

Linear System Design: Introduction to Design using Compensators, Lag Compensator, Compensator, Lag-Lead Compensator, Pi, PD and PID Controllers, Feedback Compensation, Numerical problems

State Space Analysis: Introduction, State Space Formulation, State Model of Linear System, State Diagram, State Space Representation using Physical Variables, State Space Representation using Phase Variables, State Space Representation using Canonical Variables, Solution of State Equations, Transformation of State Model, Concepts of Controllability and Observability, State Space Representation of Discrete Time System, State Space Analysis using MATLAB, Numerical problems. **10 Hours**

TEXT BOOKS

1. Control Systems Engineering,5thEdition, Norman S Nise, WileyIndia-2009
2. Modern Control Theory–Katshuhio O gata, PearsonEducation,2004.
3. Modern Control Systems–A.Nagoor Karni, Richard C Dorf & Robert H Bishop, Pearson.PrenticeHall,2009.

REFERENCE BOOKS

1. Control Systems Engineering S Palani Tata McGraw Hill Publishing Co Ltd ISBN-13 9780070671935
2. Automatic Control Systems Benjamin C Kuo, F. Golnaraghi, JohnWiley&Sons,2003.

EBOOKS / ONLINE RESOURCES

1. Feedback Systems: An Introduction for Scientists & Engineers, Karl J Astrom & Richard M Murray, Versionv2.10b, Princeton University Press. www.cds.caltech.edu/~murray/books/AM05/pdf/am08-cpmplete22Feb09.pdf
2. Control System Engineering by Nagoor Kani by Easy Engineering.net

COURSE OUTCOMES

The students at the end of the course will able to:

CO1: Identify the basic elements. Types of control systems and writing the differential

Equations for different systems

CO2: Calculate the overall gain of the system using transfer function method, block diagram Reduction tools and using signal flow graph (Mason's Gain formula)

CO3: Apply the concept of time response, frequency response and state variable analysis

CO4: Analyse the stability of a system using different stability methods

CO5: Analysing the relative stability and performance of feedback control systems using frequency methods considering phase and gain margin, and system bandwidth.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	L								M	H
CO2	H	H			L				L	M		H
CO3	H	L	L				M					M
CO4	M	L						M				M
CO5	M	L										H

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604B**			**B. Tech (Mechanical Engineering)**		
Category	Professional Elective-1				**Semester: VI**	
Course title	**BIOMATERIALS AND TECHNOLOGY**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100		Duration of SEE: 3 Hrs	
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. Understand the need of Biomaterials and its classifications and Understand Biomaterials as implant materials.
2. Analyze the development of Metal, Polymeric And Ceramic Biomaterials and Evaluate techniques of characterization of Biomaterials
3. Analyze the role of Biomaterials in the medical field and its application and Understand the terminologies in biomechanics, statics human body and introduction to muscles
4. Analyze the kinematic study of human body
5. Analyze the Testing, compatibility and applications of biomaterials

COURSE CONTENT

UNIT – 1

Introduction to Biomaterials, Need for biomaterials, Salient properties of important Biomaterial, Classification, Requirement of biomaterials, Role of bio-materials in the medical field.

10 Hours

UNIT – 2

Metallic implant materials, Ceramic implant materials, Polymeric implant materials, Composites as biomaterials, Role of metals, Polymers and ceramics in Orthopedic, Dental and other medical application.

10 Hours

UNIT – 3

Biomaterials preparation and characterization, Processing and properties of different new, Biomaterials, Mechanical and physical properties, evaluation of biomaterials, New and novel materials for biomedical applications, Design concept of developing new materials for bio-implant applications, Concept of biocompatibility ,Cell-material interactions and foreign body response, Assessment of biocompatibility of biomaterials.

10 Hours

UNIT – 4

Testing of bio-material, In-vitro and In-vivo evaluation, dissolution study, Cytotoxicity test, Cell adhesion test, sterilization of biomaterials Anti-bacterial assessment, Kirby–Bauer disc diffusion method or antibiotic sensitivity test and spread plate method. **10 Hours**

UNIT – 5

Biomaterials for drug delivery, Timed release materials, Biodegradable polymers, Blood compatible materials, Biomimetic, Bone biology, Bone architecture, Collagen, Osteoblasts, osteoclasts, Protein mediated cell adhesion, Introduction to tissue engineering, Applications of tissue engineering, Biomaterials worldwide market, Technology transfer and ethical issues, Standards for biomaterials and devices. **10 Hours**

TEXT BOOKS:

1. Biomaterials by ark, Joon Parkes and R.S Lakes,3rd Edition, Springer.
2. Fundamentals of biomaterials by Hasirci Vasif, and Hasirci Nesrin,3rd Edition,Springer.

REFERENCE BOOKS:

1. Hench L. Larry and Jones J.,(Editors),Biomaterials, Artificial organs and Tissue Engineering, Wood head Publishing Limited,2005.
2. Hench L. Larry & Wilson J.,(Editors),An Introduction to Bio-ceramics, World Scientific,1994.

EBOOKS / ONLINE RESOURCES

1. B.Basu, D.Katti and Ashok Kumar; Advanced Biomaterials: Fundamentals, Processing and Applications; John Wiley & Sons, Inc., USA (ISBN: 978-0-470-19340-2), September, 2009
2. Biomaterials Science and Biocompatibility, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.

MOOCs

1. Introduction to Biomaterials, IIT Kanpur
2. Biomaterials for bone tissue engineering applications, IISC Bangalore

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Explain the required properties of Biomaterials.

CO2: Discuss the Biomaterials applications and its role in medical field as implant.

CO3: Design and development of new materials for Bio-implant applications.

CO4: Illustrate out test on Biomaterials.

CO5: Discuss Biomaterial as future advanced materials in medical field.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any **Five** full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H					H			M	L		L
CO2	M			M	M		L		H	M		
CO3	L	L	H	L	H		H	H	M	H	M	
CO4	L	L		M	M		M		L	M		
CO5	H			L	L	L	H		M	L		L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604C**			**B. Tech (Mechanical Engineering)**		
Category	Professional Elective-1					**Semester: VI**
Course title	**CAD/CAM AND ROBOTICS**					
Scheme and Credits	No. of Hours/Week					Total hours = 50
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES:

The course will enable the students to:

1. Apply the concepts of geometrical modeling and understand the importance of applications of computers in design and manufacturing.
2. Analyze the direct applications of computers in manufacturing.
3. Analyze the indirect applications of computers in manufacturing.
4. Understand the basics of an industrial robot.
5. Evaluate the various aspects such as kinematic analysis, robot end effects and sensor in industrial robotics.

COURSE CONTENTS

UNIT-1

Introduction to CAD, CAM, CAD/CAM, Manufacturing data base, Application of Computers in Design & Manufacturing activities. Product Life cycle in Conventional & Computerized Manufacturing Environment. CAD/CAM Hardware & Software. Geometric Modeling-Wire frame, Surface & Solid Modeling, Transformation of 2D & 3D Geometric models-Translation, Scaling, Rotation, Reflection, Homogeneous Representation & Concatenation of Geometric Transformations, Problems.

10 Hours

UNIT-2

NC, CNC and DNC – working of NC/CNC machines, classification, Design features of CNC machine tool, Machining center, Turning center, Axes definition of NC systems, Part Programming – G & M codes, Punched tape Preparation as per EIA & ISO Code formats, APT language, DNC – Configuration, types, advantages, Adaptive control. Problems. **10 Hours**

UNIT-3

Group Technology and Cellular manufacturing systems–Group Technology Implementation, Part Family formation, Selection of classification and coding systems, Design of Cellular manufacturing, Cell formation approaches. Computer Aided Process Planning-Approaches, Variant, and Generative Knowledge based Process planning, Feature recognition in CAPP. Problems.

10 Hours

UNIT-4

Robotics Technology – Definition, Anatomy, Cartesian ,cylindrical, spherical, jointed, and SCARA, Robot Control Systems, Resolution Accuracy & Repeatability, Specification, Problems. Classification and Structure of Robotic systems, Point to Point and continuous path systems, Control

loops of Robotic systems, Drives and Control Systems applications Problems.

10 Hours

UNIT-5

Kinematic Analysis and Coordinate Transformation – Direct & Indirect Kinematics, Geometry based direct Kinematic Analysis of 2D and 3D Robotics systems problems.
Robot end effectors – Grippers & Tools, Mechanical & Other types of grippers. Robot Programming, Sensors in Robotics, Robot applications, Machine Vision-Components & Working of Machine Vision system for typical Industrial Robot applications problems.

10 Hours

TEXT BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing – Mikell P. Groover pub: PMI, New Delhi (1997).
2. Systems Approach to Computer Integrated Manufacturing – Nanua Singh, Pub: John Wiley & Sons.
3. Industrial Robotics: Technology, Programming & Applications – Mikell P. Groover, Mitchell Weiss, etal. Pub: Mc Grow Hill International Ed. (1988).
4. CAD/CAM Principles & Applications-P.N. Rao. Pub: Tata McGraw Hill.

REFERENCE BOOKS

1. Robotics for Engineers – Yoram Koren. Pub: McGraw Hill International Editions (1987).
2. Numerical Control Machines and Computer Aided Manufacturing.- Kunder, Tewari, Rao. Pub: Tata McGraw Hill.
3. Robots and Manufacturing Automation – C Ray Pub: John Wiley & sons.

EBOOKS / ONLINE RESOURCES

1. CAD/CAM Robotics and Factories of the Future – B. Prasad, *Springer* (1989).
2. https://automaterials.files.wordpress.com/2018/09/cad-cam-by-p-n-rao.pdf .

MOOCs

1. https://nptel.ac.in/courses/112102102 .

COURSE OUTCOMES

The students at the end of the course will be able to:
CO1: Illustrate the use of computers in various stages of products in its life cycle.
CO2: Analyze the direct applications of computers in manufacturing.
CO3: Analyze the indirect applications of computers in manufacturing.
CO4: Select a suitable robot for industrial applications.
CO5: Assess the importance of robot, end effectors and sensors.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">UNIT-1, UNIT-2 & UNIT-3</td><td colspan="2">UNIT-4 & UNIT-5</td></tr>
<tr><td>Test-1</td><td>AAT-1</td><td>Test-2</td><td>AAT-2</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
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• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

Note: SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks

CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H					M	L			L		M
CO2		L		H		M						M
CO3		L						L				H
CO4	L		M		M		M		H			L
CO5		M	L			L					M	M

L – Low, M – Medium, H – High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604D**			**B. Tech (Mechanical Engineering)**		
Category	Professional Elective-1					**Semester: VI**
Course title	**INTERNAL COMBUSTION ENGINES**					
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. To gain basic knowledge about Thermodynamic Cycle Analysis and Carburation
2. To analyze the injection system in C I engines and also electronic systems
3. To understand different combustion processes in CI and SI engines.
4. To acquire new knowledge about heat transfer within combustion chambers and cooling.
5. To understand the concepts of Emission Regulation and Control Systems and discuss new development in engines.

COURSE CONTENTS

UNIT – 1

Thermodynamic Cycle Analysis: Deviation from ideal processes, Factors affecting Fuel –Air cycles: Effect of variable specific heats, Effect of dissociation, Effect of operating variables on performance of Fuel Air cycles, Numerical problems. Effect of carburation, Factors involved in carburation Mixture requirements in S.I engine, Simple Carburetor and its limitations, calculation of air-fuel ratio. Numerical Problems. **10 Hours**

UNIT –2

Injection Systems in CI engines: Introduction to Mechanical Injection System, Functional Requirements and classification, Fuel feed pump and Fuel Injector, Spray Characteristics: spray formation, penetration, Atomization, Rate of fuel Injection using Bernoulli's equation, Numerical problems. Electronic injection systems: Types, Merits and Demerits, Multi point fuel injection system (MPFI), Electronic control system, Injection timings, Common –Rail Fuel Injection System, HCCI, RCCI. **10 Hours**

UNIT –3

Combustion Process in S.I. Engines : Theories of combustion process in S.I. engines, Knock free and knocking combustion, Effect of Knock on engine performance, Effect of operating variables on knocking., Knock rating of fuels-octane number, Knock Modeling (Numerical problems), HUCR values, Anti knock agents Pre ignition - Post ignition. Combustion in C.I. Engines: Ricardo's three stages of combustion process in C.I. engines, Delay period, factors affecting delay period, Hardenberg and Hase correlation ignition delay. Simple Numerical, Diesel knock Methods of controlling diesel knock, Knock rating of Diesel fuels. **10 Hours**

UNIT –4

Combustion Chambers: Requirements of combustion chambers, Features of different types of combustion chambers for S.I. engine, System for S.I. engine. I-head, F-head combustion chambers, Chambers, Air swirl turbulence-M type combustion chamber, C.I. engine combustion, Comparison of various types of combustion chambers. Heat Transfer in engine and cooling: Introduction, Engine Cooling, Engine Energy Balance, Cylinder Heat Transfer, Heat Transfer Modeling, Heat Transfer Correlations, Overall Average Heat Transfer Coefficient, Numerical problems. **10 Hours**

UNIT –5

Emission Regulation and Control Systems: Mechanism of pollutant formation, Total emission control package- thermal reactor package, Catalytic converter package, DOC (Diesel Oxidation Catalyst), DPF (Diesel Particulate Filters), Control of NOX -Exhaust gas recirculation, Water injection, Selective catalytic reduction, Emission norms: Bharat stage 4 and 6. Modern Developments in Engines: Super charging of I. C. engines, Factors, Methods, thermodynamic cycle, Types of superchargers, Stratified charge engines (Lean burned SI engine), Multi fuel engines, Rotary piston engine, Two injector engines, Pilot ignition engine, all ceramic swirl chamber engines, ECU mapping. **10 Hours**

TEXT BOOKS

1. A course in I.C. Engines, M. L. Mathur and R. P. Sharma, Dhanpat Rai Pub, 2001.
2. Internal Combustion Engines, Colin R. Ferguson C. John Wiley & Sons, 1986

REFERENCES BOOKS

1. I.C. Engines, Edward. F. Obert, Harper International edition, 1973.
2. Internal Combustion Engines, Ganeshan, Tata McGraw Hill, 2nd Edition, 2003.
3. Engineering Fundamentals of the I.C. Engine, Willard W. Pulkrabek. 1998.
4. Combustion Engine Process, Lichty, Judge 2000

E-BOOKS / WEB REFERENCES

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Edition, Phi Learning, 2005
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112108148/
5. http://nptel.ac.in/courses/112105123/

MOOCs:

1. https://www.coursera.org/course/introthermodynamics
2. https://www.iitbombayx.in/courses/IITBombayX/ME209xA15/2015_T1/about

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Compare ideal and real thermodynamic cycles and different types of fuels with respect to their advantages and limitations

CO2: Evaluate the engine parameters considering theoretical and actual cycles.

CO3: Analyze the current and future SI and CI engine designs, combustion processes, effect of operating variables on engine performance, effect of dissociation, variable specific heats, and exhaust dilution on thermodynamic cycles, chemical structure of fuels.

CO4: Identify the requirements of combustion process for SI and CI engines.

CO5: Understand the effect of I.C. Engine emissions on environment and public health and control them.

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE – 50 Marks</td></tr>
<tr><td colspan="2">UNIT-1, UNIT-2 & UNIT-3</td><td colspan="2">UNIT-4 & UNIT-5</td></tr>
<tr><td>Test-1</td><td>AAT-1</td><td>Test-2</td><td>AAT-2</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
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(To be Scaled down to 50 Marks)</td></tr>
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• Two full questions to be set from each unit with internal choice.
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✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

Note: * SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	M			M		L				M
CO2	M	M	H	H	L		H	L				M
CO3	L	H	L		L				M			H
CO4	M	H	H			M				L	M	H
CO5	H	M	L	M			L				M	M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE604E</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-1</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">OPERATION RESEARCH</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

The course will enable the students to:

1. To provide students the knowledge of optimization techniques and approaches.
2. To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
3. To teach students about networking, inventory, queuing, decision and replacement models.
4. To introduce students to research methods and current trends in Operations Research.

5 To teach different applications were techniques can be applied

COURSE CONTENT

UNIT-1

Introduction: Managerial Decisions, Decisions under certainty and decisions under uncertainty, Development of O. R, Definitions and essential characteristics of O. R, Phases of O. R, scope of O. R. Advantages and limitation of O. R

Linear Programming Problems: Formulation, and application, concepts of solution space, convex regions, basic feasible solution, by Graphical method, Simplex method, Big M method, Degeneracy in L. P. P, Theory of duality, Dual simplex method **10Hours**

UNIT-2

Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of 2 jobs on 'm' machines using graphical method. Replacement Analysis: Causes for replacement and types of replacement problems, Items deteriorating with time, Items with sudden failure, problems

Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models – Production models – Stochastic Inventory models – Buffer stock. **10Hours**

UNIT-3

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment

problems.
Travelling Salesman Problem (TSP). Difference between assignment and T.S.P Numerical Problems. **10Hours**

UNIT-4

Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks differences between PERT and CPM–Numerical Problems. **10Hours**

UNIT-5

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulation of games.
Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models. **10Hours**

TEXT BOOKS

1. Operations Research, P K Gupta and D S Hira S, Chand and Company Ltd, New Delhi 2007
2. Operations Research, An Introduction Hamdy A. Taha PHI Private Limited ,7th Edition, 2006

REFERENCE BOOKS

1. Operations Research, A M Natarajan, P Balasubramani, Pearson Education, 2005
2. Introduction to Operations Research, Hillier and Lieberman, 8th Ed., McGraw Hill 2001
3. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016

EBOOKS / ONLINE RESOURCES

1. https://onlinecourses.nptel.ac.in/noc22_ma48/preview
2. https://nptel.ac.in/courses/112106131
3. https://archive.nptel.ac.in/courses/112/106/112106134/
4. https://nptelvideos.com/course.php?id=768

MOOCs

1. https://onlinecourses.nptel.ac.in/noc22_ma48/preview
2. https://www.classcentral.com/course/swayam-operations-research-14219
3. https://www.coursera.org/courses?query=operations%20research
4. https://www.udemy.com/course/operations-research-intro/

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Apply operations research techniques like L.P.P, scheduling and sequencing in industrial Optimization problems.

CO2: Solve transportation problems using various OR methods.

CO3: Illustrate the use of OR tools in a wide range of applications in industries.

CO4: Analyze various OR models like Inventory, Queuing, Replacement, Decision etc and apply them for optimization.

CO5: Gain knowledge on current topics and advanced techniques of OR for industrial solutions.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">UNIT-1, UNIT-2 & UNIT-3</td><td colspan="2">UNIT-4 & UNIT-5</td></tr>
<tr><td>Test-1</td><td>AAT-1</td><td>Test-2</td><td>AAT-2</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
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</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1				H		L			M			
CO2		M		M						H		M
CO3	H						L		M	M		H
CO4		L	L	M	M			L				
CO5		M			M				M	M	L	M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604F**			**B. Tech (Mechanical Engineering)**		
Category	Professional Elective-1					**Semester: VI**
Course title	**INDUSTRIAL MANAGEMENT**					
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. Understand the functions and functional areas of management, Organization structure.
2. Analyze the industrial relations, Legislation factors related to industries, Studies about the work procedure and working environments.
3. Evaluate the work study and time study.
4. Understand the value engineering, purchasing and Sales management.
5. Understand the concepts of value engineering, Purchasing and scales.

COURSE CONTENT

UNIT-1

Introduction: Brief history of development of management thoughts, Contribution by pioneers, Functions, Principles of management and functional areas of management.

Organization: Definition of organization, Principles and objectives of organization, Types, system approach to organization, Management of change, management of conflict, MBO, Management by exception. **10 Hours**

UNIT-2

Industrial Psychology and Human Relation: Motivation, Theories of human motivation, Maslow's hierarchy of needs, group dynamics, theories of X & Y, Hawthorne's experiments.

Personnel Management: Functions of personnel management, Recruitment, Selection and Training, Wages, Salary administration, Intensives, Wage payments. **10 Hours**

UNIT-3

Industrial Ownership: Types of ownership, Methods of raising capital, Incorporation of Joint Stock Company.

Industrial Relationship: Trade union movement in India, Machinery for settlement of disputes, Handling of individual grievance, Work of ILO. **10 Hours**

UNIT-4

Work Study: Introduction, work study procedure, Human considerations in work study concepts of work content, works study as a tool to improve productivity, Lean manufacturing, Kaizen and Kanban Approach, JIT, Six Sigma.

Time Study: Objectives, Techniques of work measurement, Time study equipment's, Computation of standard time, Work sampling, Motion time analysis. **10 Hours**

UNIT-5

Value Engineering: Definition, Value analysis, Steps in value analysis
Purchasing: Functions and procedure, Types of purchasing, Inventory and Inventory management.
Sales Management: Market research, Sales forecasting, Factors to be consider for sales forecast, Pricing, Sales promotion and distribution. **10 Hours**

TEXT BOOKS:

1. Principles of Management-Koontz & O'Donnell, Publisher: McGraw-Hill Education – Europe, ISBN: 9780070581920, 0070581924
2. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 4th Edition, 2010.
3. Industrial Engineering and Management-17th Edition Dhanpath Rai and Sons. ISBN: 9788189928353.
4. Modern Production Management-Buffa, 8th Edition, Wiley, - Wiley series.

REFERENCE BOOKS:

1. Personnel Administration: Pogors and Mayers
2. Management of operational behavior- Hersey and Balanchard
3. Industrial relations in India-K Subramanian,
4. Indian Financial Systems- V Girish, S Sunil Kumar, Skyward Publishers,2017.

COURSE OUTCOMES:

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

CO1: Understand the history, General concepts in management, Functions and areas to which management can be applied.

CO2: Conceptualize Psychological aspects of the human, Human behavior in the organizations, Emotions, Work dedications.

CO3: Analyze Industrial ownership, Types of ownership, Industrial relations, Rules.

CO4: Understand Work study, Techniques in work study advantages and disadvantages of work study, Time study.

CO5: Explain Value engineering, Pricing, Purchasing techniques, Type of purchase, Sales management, Types of sales.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
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CO: GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L								M	H
CO2	H	L	L						L			M
CO3	H	H	L	L								H
CO4	H	H	L	L	M	L		M		L		M
CO5	H	M	H			L						M
CO6	H	M	L		M		M				M	M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604G**			**B. Tech (Mechanical Engineering)**		
Category	Professional Elective-1				**Semester: VI**	
Course title	**PRODUCT LIFE CYCLE AND MANAGEMENT**					
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. Understand the basic concepts of Product Life Cycle Management.
2. Apply and analyze Product Life Cycle Management functionalities.
3. Analyze and Evaluate Product Life Cycle Management processes and workflow.
4. Understand and apply Product Life Cycle Management solution management steps for implementation.
5. Create a strategy to develop a typical Product Life Cycle Management system.

COURSE CONTENT

UNIT-1

Introduction to Product Life Cycle Management (PLM): Product data management (PDM) – systems, importance, functions, applications and necessities from PDM to PLM. Introduction to PLM, PLM Lifecycle model, Threads of PLM, Need for PLM, Opportunities and benefits of PLM, Views, Components, functions and Phases of PLM. **10 Hours**

UNIT-2

PLM Functionalities- PLM functions; part management, document management, CAD management, change management, BOM management-EBOM, MBOM, As built BOM, service BOM.

10 Hours

UNIT-3

PLM Concepts, Processes and Workflow: Characteristics of PLM, Environment driven PLM,PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, PLM Process, Flowchart vs, Rule-based workflows, Implementation of PLM workflows, Support of PLM, product description data, Data models, Life cycles of individual items, status of items.

10 Hours

UNIT-4

Developing a PLM strategy and conducting a PLM assessment: PLM Strategies, Impact of strategy, Brief study on implementing a PLM strategy, PLM initiatives to support corporate objective, PLM Workflow Tool Dream, Infrastructure assessment, assessment of current systems and applications. **10Hours**

UNIT-5

PLM Solution Management for Implementation- Design, development and testing different phases of PLM solution development and execution methodologies – water fall and agile, validation and testing, Software tools and case studies. **10Hours**

TEXT BOOKS

1. Michael Grieves, "Product Lifecycle Management",McGraw-Hil, Edition 2006.ISBN 0071452303.
2. Mariusz Cholewa, "Product Lifecycle Management", Wroclaw University of Technology 2011, ISBN 97883-32098-15-6
3. **"**Product data management", Burden Rodgee Resources pub 2003.ISBN 0970035225.

REFERENCE BOOKS

1. Fabio Giudice, Guido La Rosa, "Product Design for the environment-A life cycle. Approach", Taylor & Francis 2006.
2. Saaksvuori Antti / ImmonenAnselmie, "Product Life Cycle Management", Springer Pub 2005, Dreamtech, 3-540-25731-4.
3. Michael Grieves, "Product Lifecycle Management", Tata McGraw Hill Pub 2006.
4. Relevant information available in internet and reports published

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Explain the basic concepts of Product Life Cycle Management.
CO2: Implement and emphasize Product Life Cycle Management functionalities.
CO3: Assess PLM processes and workflow.
CO4: Implement PLM solution management steps for implementation.
CO5: Design and develop a strategy to implement a typical PLM systems.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M		H	L	M	H		H	M	H	
CO2	H		H		H	M		H	M	L	M	L
CO3		H	M		M	H	L	M		M		M
CO4	H	L	M	M		M	H	L	H	M		M
CO5		M		M	H	L	M	H	L	M	H	L

L – Low, M – Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEPE604H**			**B. Tech (Mechanical Engineering)**			
Category	Professional Elective-1					**Semester: VI**	
Course title	**NON TRADITIONAL MACHINING PROCESSES**						
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs	
	L	T	P	SS	Credits		
	2	2	0	0	3		
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs	
Prerequisites (if any): NIL							

COURSE OBJECTIVES:

The course will enable the students to:

1. To make the students to understand the advanced manufacturing techniques evolved in manufacturing scenario.
2. To learn various concepts related to modern machining processes & their applications.
3. To describe the principle of material removal mechanism of advanced machining processes such as mechanical, electro- chemical and thermal
4. To appreciate the differences between conventional and non-conventional machining processes.
5. To understand the significance of the ultrasonic and abrasive jet machining.
6. To explore in-depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine materials.

UNIT-1

Need for modern manufacturing methods: Non-traditional machining methods and rapid prototyping methods- their relevance for precision and lean manufacturing. Classification of non- traditional process – their selection for processing of different materials and the range of applications. Introduction to rapid prototyping – Classification of rapid prototyping methods- streolithography, fused deposition methods – materials, principle of prototyping and various applications

10 Hours

UNIT-2

Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters on USM, Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM.

Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD).Process characteristics, Applications, advantages & limitations of AJM.

Water Jet Machining (WJM): Equipment & process, Operation, applications, advantages and limitations of WJM.

10 Hours

UNIT-3

Electro Chemical Machining (ECM): Introduction, Principle of electro chemical machining: ECM equipment, elements of ECM operation, Chemistry of ECM. ECM

Process characteristics: Material removal rate, accuracy, surface finish, Process parameters, Applications of ECM, Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH.
Chemical Machining (CHM): Elements of the process: Resists (maskants), Etchants. Types of chemical machining process, chemical blanking process, chemical milling process. Process characteristics of CHM, advantages, limitations and applications of chemical machining process. 10 Hours

UNIT-4

Electrical Discharge Machining (EDM): Introduction, mechanism of metal removal, EDM equipment: spark erosion generator (relaxation type), dielectric medium-its functions & desirable properties, electrode feed control system. EDM process parameters, Advantages, limitations & applications of EDM, Electrical discharge grinding, Traveling wire EDM.
Plasma Arc Machining (PAM): Introduction, non-thermal generation of plasma, equipment mechanism of metal removal, Plasma torch, process parameters, process characteristics, applications, advantages and limitations.

10 Hours

UNIT-5

Laser Beam Machining (LBM)
Introduction, generation of LASER, Equipment and mechanism of metal removal, LBM parameters and characteristics, Applications, Advantages & limitations.
Electron Beam Machining (EBM)
Introduction, Principle, equipment and mechanism of metal removal, applications, advantages and limitations.

10 Hours

TEXT BOOKS

1. Mishra, P. K., Non-Conventional Machining, The Institution of Engineers (India), Text Book Series, New Delhi, 1997
2. Garry F. Benedict, Unconventional Machining Process, Marcel Dekker Publication, New York, 1987

REFERENCE BOOKS

1. Bennedict, G. F., Non Traditional Machining Techniques, Marcel Decker, New York, 1990
2. Sharma, P. C., A Text book of Production Engineering, New Delhi, 1995
3. Pandey and Sha, Modern Manufacturing Process, Prentice Hall, New Jersey.
4. HMT Production Technology, Tata McGraw Hill, 2001

EBOOKS / ONLINE RESOURCESS

1. http://www.learnerstv.com/free-Engineering-video-lecturers-ltv234-page 1.htm
2. http://www.learnerstv.com/free-Engineering-video-lecturers-ltv530-page 1.htm

MOOCs

1. https://www.classcentral.com/course/swayam-advanced-machining-processes-19791
2. https://www.udemy.com/course/non-conventional-machining-processes/

COURSE OUTCOMES

The students at the end of the course will be able to

CO1: Understand the compare traditional and non-traditional machining process and recognize the need for Non- traditional machining process.

CO2: Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.

CO3: Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.

CO4: Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.

CO5: Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">Unit-1 , Unit-2 and Unit-3</td><td colspan="2">Unit -4, Unit-5</td></tr>
<tr><td>Test -1</td><td>AAT -1</td><td>Test -2</td><td>AAT -2</td></tr>
<tr><td>20 marks</td><td>05 marks</td><td>20 marks</td><td>05 marks</td></tr>
<tr><td colspan="4">SEE – 20 * 5 = 100 Marks
(To be scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choices
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks
• Answer any Five full questions choosing at least one full question form each unit.</td></tr>
</table>

CO-GA MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L		M							
CO2	H	M	L		M							
CO3	M	L			H							
CO4	M	M			M							
CO5	M	M			M							

L- Low, M- Medium, H-High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEOE605A**			**B. Tech (Mechanical Engineering)**		
Category	Open Elective-1					**Semester: VI**
Course title	**INDUSTRIAL SAFETY**					
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3 Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. Identify Hazards and safety practices in industry.
2. Understand the safety practices and best practices in maintenance engineering.
3. Apply the techniques of fault tracing.
4. Evaluate the parameters for industrial safety.
5. Design and develop a model for better safety in working environment.

COURSE CONTENT

UNIT-1

INDUSTRIAL safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention and firefighting, equipment and methods. **08Hours**

UNIT-2

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment**.** **08Hours**

UNIT-3

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun, Splash

lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods**.** **10 Hours**

UNIT-4

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, Any one machine tool, Pump , Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes. **10Hours**

UNIT-5

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance, Software tools and case studies. **14 Hours**

TEXT BOOKS

1. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.

REFERENCES BOOKS

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company.
2. Audels, "Pump-hydraulic Compressors", Mcgrew Hill Publication.
   Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall.

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: List and memories safety practices used in industries.
CO2: Implementation of safety system in working environment.
CO3: Predict the occurrences of hazards and build safety measures to prevent it.
CO4: Validate the safety measures and reliability.
CO5: Integrate the advanced safety systems to the industries.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1		H	M	M	L	H	L	H	M	M	H	M
CO2	H	M	L		H	M	H	M		H	M	L
CO3	M	L	H	H	M				H	M	L	M
CO4		H	M	M		H	H	H	M	L	M	H
CO5	M	M			H	M	M	M	L	H		M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEOE605B**			**B. Tech (Mechanical Engineering)**		
Category	Open Elective-1				**Semester: VI**	
Course title	**FUNDAMENTALS AEROSPACE ENGINEERING**					
Scheme and Credits	No. of Hours/Week					Total hours = 50hrs
	L	T	P	SS	Credits	
	2	2	0	0	3	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. Understand the history and basic principles of aerodynamics.
2. Demonstrate and explain foundation of flight, aircraft structures, material, aircraft propulsion.
3. Explain the working of each component of an aircraft.
4. Assess the effect of design parameters on the performance of the aircraft and its components.
5. To evaluate the working of aircraft by using wind tunnel.

COURSE CONTENT

UNIT –1

Aircraft Configurations: Brief History- airplanes and Helicopters – Components of an airplane and their functions. Different types of flight vehicles, classifications, and Basic instruments for flying.

Introduction to Principles of Flight: Physical properties and structure of the atmosphere, Temperature, pressure and altitude relationships, Evolution of lift, drag and moment, different types of drag, Numerical problems on lift and drag. **10 Hours**

UNIT –2

Introduction to Aerodynamics: Aerodynamic forces on aircraft, Basic characteristics of aerofoils, NACA nomenclature, Classification of NACA aero foils, propagation of sound, Mach number, subsonic, transonic, supersonic, hypersonic flows.

Elements of Airplane Performance: Introduction, Equation of motion, thrust required for level unaccelerated flight, thrust available and maximum velocity, Power required for level unaccelerated flight, Power available and maximum velocity for reciprocating engine – propeller combination and jet engine, Altitude effect of power available and power required. Rate of climb, gliding flight, Absolute and Ceiling, Time of climb, Range & Endurance for propeller driven and jet air plane. **10 Hours**

UNIT –3

Aircraft Structures: General types of construction, Monocoque and Semi-Monocoque - construction, Typical wing and fuselage Structures. Geodesic structures.

Landing Gears: Introduction to Landing Gears, Types of Landing Gears, Instrument Landing System. Aircraft Break system, Types of breaks. **10 Hours**

UNIT-4

Aircraft Materials: Metallic and non-metallic materials for aircraft application, Use of aluminum alloy, titanium, stainless steel and composite materials.

Systems and Instruments: Conventional control, engine control system, Powered controls, Basic instruments for flying, typical systems for control actuation. Distance measuring instrument (DME). **10Hours**

UNIT-5

Jet Propulsion: Evolution of Aircraft Propulsion, Basic ideas about piston, turboprop and jet engines – comparative merits, Propellers and Jet for thrust production.

Rocket Propulsion: Evolution of spacecraft technologies, Principle of operation of rocket, types of rocket and typical applications, Use of multistage rockets. **10Hours**

TEXT BOOKS

1. Kermode,A.C., 'Flight without Formulae', Pearson,2004
2. Shevell,R.S., Fundamentals of flights, Pearson education 2004

REFERENCE BOOKS

1. Anderson.J.D., Introduction to Flight, McGraw Hill,2010
2. McKinley.J.L. and R.D. Bent, Aircraft Power Plants, McGraw Hill1993
3. Pallet.E.H.J. Aircraft Instruments & Principles, Pearson 2010
4. Aircraft structural Analysis, T.H.G Megson, 4th Edition, 20013, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4. 4
5. Flight stability and automatic control, Nelson R.C, 2nd Edition, 1998, McGraw-Hill International Editions, ISBN 9780071158381. 5
6. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Ian Moir, Allan Seabridge, 3rd Edition, 2008, John Wiley & Sons,. ISBN 978111965006

EBOOKS / ONLINE RESOURCES

1. Radhakantha Padhi., Advance Control System Design, NPTEL Course Material, Department of Aerospace Engineering, Indian Institute of Science Bangalore. https://youtu.be/OviQOsNvvzw
2. Prof Bhaskar Roy., Jet aircraft Propulsion, NPTEL Course Material, Department of Aerospace Engineering, Indian Institute of Technology Bombay , https://youtu.be/PcPBYh6Cfao
3. Prof Prabhu Ramachandran., Vertical axis wind turbine, NPTEL Course Material, Department of Aerospace Engineering, Indian Institute of Technology Bombay.

MOOCs

1. https://youtu.be/zKzCd1mbrb4
2. https://youtu.be/JczT33rgeKkZ8C?hl=en&gbpv=1&pg=PR7&printsec=frontcover
3. https://youtu.be/nZmvLNhcK_w

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: To explain flow regimes (viscous/non-viscous; compressible/incompressible aerodynamics) and to estimate viscous and thermal effects.

CO2: To compute lift/drag of simple aero foil configurations

CO3: To describe reference frames and derive general equations of motion for flight and orbital mechanics

CO4: To apply equations of motion to determine aircraft performance in steady gliding, horizontal and climbing flight.

CO5: To derive aircraft performance diagram and flight envelope, in relation to aircraft morphology, lift-drag polar and engine performance.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L			M					L	L
CO2	H	H	H	M	H		H			L		M
CO3	H	M	L			L		M				L
CO4	M	H	L	L				M		M		M
CO5	H	H	L		L				L		M	M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEOE605C</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Open Elective-1</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">ENGINEERING ECONOMICS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

The course will enable the students to:

1. To help the students to understand the fundamental concepts and principles of economics, costs, replacements methods.
2. To important knowledge, with respect to concepts, principle and practical applications of economics.
3. To governing the functioning of a firm/organization under different market conditions.
4. To emphasizes the developing economics to apply the value of engineering.
5. To analyze the fast growing modern economics to the various sectors of market.

COURSE CONTENT

UNIT -1

Introduction: Engineering decision – makers, engineering and economics, problem solving, intuition and analysis, tactics and strategy with an example. Interest and Interest Factors: Interest rate, simple interest compound interest, interest formulae, time value equivalence exercises, problems and discussion. **10Hours**

UNIT -2

Present Worth Comparison: Conditions for present worth comparisons, rule 72, basic present worth comparisons, present worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems. future worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems. **10Hours**

UNIT -3

Future worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems, Rate of return, minimum acceptable rate of return, IRR, IRR cost of capital concept. **10Hours**

UNIT -4

Depreciation: Introduction, causes of depreciation, methods of depreciation, problems. Reasons- Deterioration, obsolescence, inadequacy, Replacement Analysis: advantages of replacement criteria problems. **10Hours**

UNIT -5

Estimating and Costing: components of costs such as direct material cost, direct labor cost, Fixed, over – heads, factory costs, administrative – overheads, first cost, selling price, calculation of the total cost of various components, mensuration, estimation of simple components. **10Hours**

TEXT BOOKS

1. Engineering Economy,Riggs J L,McGraw Hill,4th Edition.
2. Engineering Economy,huesen H G,PHI,2002.
3. Mechanical Estimation,.R Banga and S C Sharm,Khnna Pubshers,17th Edition.

REFERENCE BOOKS

1. Chan S Park,Contemporary Engineeeirng Economics,Prentice hall of India,2002.

EBOOKS/ONLINE RESOURCES

1.https://www.udemy.com/course/fundamentals-of-engineering-economics/

COURSE OUTCOMES

The students at the end of the course will be able to:
CO1: Understand needs, functions, roles and evolution of economics.
CO2: Select the best economic model from various available alternatives.
CO3: Understand various interest rate methods and implemented the suitable one.
CO4: Estimate various depreciation values of commodities.
CO5: Understand the solidification process and casting of Non-Ferrous metals.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT-1, UNIT-2 & UNIT-3		UNIT-4 & UNIT-5	
Test-1	AAT-1	Test-2	AAT-2
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any **Five** full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L		M							M
CO2	H	M	L		M							M
CO3	M	L		L	H		H		L		M	H
CO4	M	M			M	M		L				L
CO5	M	M			M					M		M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC606L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">MEASUREMENTS AND METROLOGY LAB</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total hours = 32hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

The course will enable the students to:

1. Identify and classify different measuring tools related to experiments and Identify, define, and explain accuracy, precision, and terminology related to Measurement & Metrology.
2. Conduct, Analyze, interpret, and present measurement data from measurements experiments.
3. Identify sources of variability, error, and uncertainties and Demonstrate excellent laboratory skills and techniques including the proper use of relevant instruments in metrology and measurement.
4. Enhance the ability to apply knowledge of mathematics, statics, physics and engineering sciences.
5. To bridge the gap between workshop standards and master standards.

COURSE CONTENT

PART-A: MEASUREMENTS

1. Determination of elastic constants using strain gauges from the following experiment: A constant stress cantilever beam subjected to a concentrated end load.
2. Determination of gauge factor and cross sensitivity of a given strain gauge.
3. Calibration of load cell and pressure gauge with strain gauge.
4. Calibration of LVDT and study of characteristics of LVDT.
5. To study the amplitude and the frequency of unknown wave forms using CRO. Study of Lissajous diagrams for studying frequency and phase relations.
6. Determination of time constant of first order system such as thermocouple.
7. Calibration of thermocouple using resistance thermometer.
8. Use of pyrometers total radiation and optical pyrometers. 16Hrs

PART-B: METROLOGY

1. Measurement of Surface Finish.
2. Measurement of angle USING Sine bar

3. Measurement of center distance between holes
4. Measurement of internal and external taper.
5. Measurement of pitch and profile errors of threads and gears.
6. Use of comparators.
7. Measurement of radius of components.
8. Measurement of form factors of Gear 16Hrs

TEXT BOOKS:

5. Mechanical Measurement-Beckwith & Buck, Roy. D. Marangoni, John. H. Lienhard.
6. Mechanical Measurements- Sirohi & Radhakrishna
7. Mechanical Measurements- RK Jain

REFERENCE BOOKS:

1. Experimental methods for engineers - J. P. Hollman
2. Engineering Measurements -Deoblin
3. Engineering Measurements –Collet & Hope.

EBOOKS / ONLINE RESOURCES

1. Engineering Metrology And Measurements N.V.Raghavendra, L.Krishnamurthy
2. A Textbook of Measurements & Metrology, R.K.Rajput

MOOCs

1. Mechanical Measurements and Metrology, IIT Madras
2. Principles of Mechanical Measurements, IIT Madras

COURSE OUTCOMES

The students at the end of the course will be able to:

CO1: Analyze the measuring of various parameters like length, height, angle, displacement, flatness etc., by using various measurement systems

CO2: Illustrate the measurement of Gear tooth profiles and surface roughness using appropriate instruments and analyze the data.

CO3: Emphasize the measurement of mechanical parameters like strain. Temperature, pressure and frequency.

CO4: Analyze the role of measurement system in industry & research Centre.

CO5: Illustrating measurement by using different types of standards.

SCHEME OF EXAMINATION

Continuous Internal Evaluation (Laboratory- 50 marks)	**Marks**	**Semester End Evaluation (SEE) (Laboratory -100 marks)**	**Marks**
Performance of the student in the laboratory every week	20	Write up	20
Test at the end of the semester	20	Experiment 1(Part-A) = 30 marks Experiment 2(Part-B) = 30 marks	60
Viva Voce	10	Viva Voce	20
		Total	**100**
Total (CIE)	**50**	**Total (SEE)**	**50***

Note: * =SEE shall be conducted for 100 marks for practical and the marks obtained shall be reduced for 50 marks

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H				L		H		H		L	H
CO2	H	M		L	H			L	M			L
CO3	M	L										L
CO4	H			H	M	H						M
CO5	M	H	H	H	H	H		L		H	H	L

L – Low, M – Medium, H - High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPC607L</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">DESIGN LABORATORY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 32hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

The course will enable the students to:

1. To understand the working of various mechanisms and measurements of velocity, accelerated of simple mechanisms.
2. To understand the concepts of power transmission, gyroscope, vibrating systems, balancing and governors.
3. To emphasize the concepts of photo elastic techniques for measuring stresses and strain.
4. To estimate the concepts of strain measurements-using strain gauge techniques.
5. To understand the various parameters involved in lubrication of moving parts.

COURSE CONTENT

PART-A

1. To study motion of the follower for the given cam and determine the displacement, velocity and acceleration at every point (cam analysis).
2. Determination of Gyroscopic couple.
3. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a longitudinal vibrations system.
4. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a torsional vibration systems.
5. Determination of critical speed of a rotating shaft (whirling of shaft).
6. Static balancing of masses.
7. Balancing of rotating masses.
8. Determination of equilibrium speed, sensitiveness power and effort of porter and Hartnell governor.
9. Calibration of photoelastic model material by using a beam subjected to pure bending. 16Hrs

PART-B

10. Determination of stress concentration factors in a plate with a circular cut out under uniaxial tensile load using strain gauges.
11. Determination of magnitudes and directions of a principal stress, principal strain, maximum shear stress and maximum shear strain using strain rosettes.
12. Study of Pressure distribution and coefficient of friction in journal bearing.
13. Study of pressure distribution and coefficient of friction in slider bearing.
14. Study of wear resistance of engineering materials using pin on disc apparatus.
15. Calibration of photo-elastic model material by using circular disc under diametrical compression.

16. Determination of stress concentration factor in a plate with circular hole under tension.
17. Determination of contact stress & sub surface shear stress in a circular cut out subjected to uni-axial tensile load.
18. Determination of stress concentration factor in plate with circular cut out under transverse bending.

*Comparison using FEM commercial software. 16Hrs

TEXT BOOKS

1. Theory of Machines – Shigley & Uicker.
2. Theory of Machines – Ballany.
3. Theory of Machines – Sadhu Singh.
4. Fundamentals of Mechanical Vibrations – S Graham Kelley.
5. Theory & Practice of Mechanical Vibrations – J S Rao & K G Gupta.
6. Experimental stress Analysis – L S Srinath, M R Raghavan, K Lingaiah,

REFERENCE BOOKS

1. Experimental stress Analysis – Dally and Riley.
2. Lubrication of Bearings by Radzimovsky.
3. Principles and Applications of Tribology by Moore.
4. Strain Gauge by Primer.
5. Introduction to FEM – T. Chandrupatla. and Belagundu.

COURSE OUTCOMES:.

CO1: Analyze change of position, velocity and acceleration of cam.

CO2: Apply the concepts of power transmission, gyroscope, vibrating systems, balancing and governors for efficient functioning of a system.

CO3: Evaluate the strain at the critical points of a component using strain gauge techniques.

CO4: Analyze the various parameters involved in lubrication of moving parts for preventing failure within the service life.

CO5: Analyze by correlating the stresses and strains measured using photo-elastic technique to the actual components.

SCHEME OF EXAMINATION.

Continuous Internal Evaluation (CIE) (Laboratory-50 Marks)	**Marks**	**Semester End Examination (SEE) (Laboratory-100 Marks)**	**Marks**
Performance of the Student in the Laboratory every week	20	Write up	10
Test at the end of the Semester	20	Experiment-1 (Part-A) = 35 Marks Experiment-2 (Part-B) = 35 Marks	70
Viva-Voce	10	Viva-Voce	20
		Total	**100**
Total (CIE)	**50**	**Total (SEE)**	**50***

Note:* = SEE shall be conducted for 100 Marks for Practical and the Marks obtained shall be reduced for 50 Marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	L	L	M				L			L	L
CO2	L	M	M	M								L
CO3	M	M	H	M		L			H	M		M
CO4	L	H	M	H	M	L	M	L				M
CO5	L	H	M	H						L	L	M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEMP608</td><td colspan="3">B. Tech (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="5">Mini Project</td><td>Semester: VI</td></tr>
<tr><td>Course title</td><td colspan="6">MINI PROJECT</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours/week = 7hrs</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>4</td><td>2</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students to:

1. To equip students for making a technical presentation based on a thorough research Review on any contemporary area of Engineering and Management fields
2. Offering the student an opportunity to interact with faculty and peer group and to Build the ability to making independent presentation.
3. Propose research question and present them in a clear and distinct manner through different oral, written and design techniques.

COURSE CONTENT

- It can be assigned to an individual student or a group having not more than 4 students to work on a topic approved by the Head of the Department and prepare a comprehensive mini project report after completing the work to the satisfaction.
- Students should understand testing of various components.
- The progress of the project is evaluated based on a minimum of two reviews.
- The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Department.

COURSE OUTCOMES:

CO1: Students will be able to practice acquired knowledge within the chosen area of technology for project development.
CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
CO3: Reproduce, improve and refine technical aspects for engineering projects.
CO4: Work as an individual or in a team in development of technical projects.
CO5: Communicate and report effectively project related activities and findings.

SCHEME OF EXAMINATION

Each faculty member is to be assigned 2 to3 batches of students each batch may have 4 or 5 students. The assessment is to be conducted for 50 marks for CIE and 100 Marks for SEE and reduced to 50 marks to be incorporated in the result. Internship Seminars has to be presented once in 15 days with the concern of the respective Guide/s, Coordinator and Chairperson about the progress of the Mini Project.

For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Topic of internship	10%	50
2.	Objectives of internship	10%	
3.	Specific skills acquired	20%	
4.	Documentation	40%	
5.	Presentation	20%	
Total		100%	

Each student is required to maintain an individual logbook, where he/she is supposed to record day to day activities. The project log is assessed on an individual basis, thus allowing for individual members within groups to be assessed this way. The assessment will take into consideration the individual student's involvement in the assigned work.

Rubrics for SEE:

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Topic of internship	10%	100 To be reduced to 50
2.	Objectives of internship	10%	
3.	Specific skills acquired (Write up about in Internship)	20%	
4.	Presentation	40%	
5.	Viva-Voce	20%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H									M
CO2	H	H	M									M
CO3	H	H	M									L
CO4	H	H	M									L
CO5	H	H	H									L

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

Course Code	**21MEAE609**			**B. Tech (Mechanical Engineering)**		
Category	Ability enhancement Course					**Semester: VI**
Course title	**CAD/CAM AND ROBOTICS LAB**					
Scheme and Credits	No. of Hours/Week					Total hours = 32hrs
	L	T	P	SS	Credits	
	0	0	3	0	1	
CIE Marks: 50	SEE Marks: 50		Total Max. Marks: 100			Duration of SEE: 3Hrs
Prerequisites (if any): NIL						

COURSE OBJECTIVES

The course will enable the students to:

1. Analyze CNC Machines and Programming concepts to produce a component on CNC machines.
2. Understand the Robot Anatomy, control Systems and concept of robot programming.
3. Apply direct and inverse transformation for Kinematic analysis of 2D robot arm.
4. Analyze and evaluate concepts of computer vision to built inspection system.
5. Create an automated inspection system by interfacing computer vision with robot to inspect the machined components.

Part A

1. Programming and Demonstration of production of components using CNC lathe.
2. Programming and Production of Components using CNC milling machine.
3. Use of master CAM to generate part programs for simple axis symmetric and prismatic components. **16 Hours**

Part B

1. Computer simulation and programming of robots for pick and place, stacking, palletizing, assembly, inspection, etc. applications using suitable software and hardware.
2. Use of Computer vision and interfacing with robots for industrial applications.

Experiments of Direct and Inverse Kinematic analysis of two dimensional three degrees of freedom robotic arm.

16 Hours

REFERENCE BOOKS

1. Numerical Control Machines and Computer Aided Manufacturing.-Kunder, Tewari, Rao. Pub: Tata McGraw Hill.

2. Automation, Production Systems and Computer Integrated Manufacturing – Mikell P. Groover pub: PMI, New Delhi (1997).
3. CAD/CAM Principles & Applications-P.N. Rao. Pub: Tata McGraw Hill.

MOOCs

1. https://www.classcentral.com/course/swayam-cad-cam-computer-aided-design-computer-aided-manufacturing-22925
2. https://www.classcentral.com/course/introduction-cad-cam-practical-cnc-machi-15215

COURSE OUTCOMES

Students shall be able to:

CO1: Implement the concepts of CNC programming to set and machine a component on CNC lathe and milling machines.

CO2: Design robot cells and program for various industrial applications using simulation software.

CO3: Solve problems on direct and inverse kinematic analysis of 2D robot arm and verify practically.

CO4: Experiment on computer vision to inspect simple parts.

CO5: Investigate an automated inspection system developed by interfacing computer vision with Robot.

SCHEME OF EXAMINATION

Continuous Internal Evaluation (Laboratory– 50 marks)	**Marks**	**Semester End Evaluation (SEE) (Laboratory – 100 marks)**	**Marks**
Performance of the student in the laboratory every week	25	Write up (Part-A) = 20 marks Write up (Part-B) = 20 marks	40
Test at the end of the semester Experiment-1(Part-A)=10marks Experiment-2 (Part-B) = 10 marks	20	Experiment-1 (Part-A) = 20 marks Experiment-2 (Part-B) = 20 marks	40
Viva Voce	05	Viva Voce	20
Total (CIE)	**50**	**Total**	**100 ***

Note: * SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H				M					H		M
CO2	H		H			M		M				H
CO3	H				M		L				M	M
CO4	H	M	M		M	M		M	H			H
CO5	H			H			M			H		M

L – Low, M – Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="5">21MEIN610</td><td colspan="2">B. Tech (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="6">Internship</td><td>Semester : VI</td></tr>
<tr><td>Course title</td><td colspan="7">PLACEMENT INTERNSHIP-III</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3"></td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CIE Marks: Nil</td><td colspan="2">SEE Marks: Nil</td><td colspan="3">Total Max. Nil</td><td colspan="2">Number of Activities points = 20</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

1. To provide career guidance about avenues open after graduation. ie. Higher education, placements or entrepreneurship
2. To provide recruitment to students.
3. To have good relations with the recruiters.
4. Managing Recruiters correspondence and also in Organizing Pre- Placement Training and Mock Interview.
5. Planning and organizing various Placement drives in campus, Finding, informing and managing Pool Placements drives.
6. To build the bridge between industry and academia.

GUIDELINES

1. To be carried out during the VI semester offered by the Training and Placement Office (TPO) UVCE. On successful completion, students will be awarded 20 activity points.
2. Placement training plays a major role in equipping students with requisite soft and technical skills before the commencement of placement drive.
3. The placement internship offered by TPO provides requisite knowledge in the areas of communication skills, presentation skills, leadership training, logical puzzles, group building exercises, group discussions, lateral thinking, quantitative aptitude, verbal aptitude, technical skills, interview training and resume writing, logical reasoning, analytical reasoning, coding, Mock HR interviews, etc.
4. There are no grades attached to placement internship. However, the successful participation by students in pre-placement training shall be entitled for award of 20 activity points.

Activity Points (CBCS-NEP 2020-2021 Regulations)

Students should have excellent soft skills, leadership qualities, and team spirit apart from technical knowledge and skills, to be successful as professionals. They should have entrepreneurial capabilities and societal commitment. Every regular student, who is admitted

to the 4 years Degree program, is required to earn 100 Activity Points in addition to the required academic grades. Lateral entry students are required to earn 75 Activity Points, in addition to the academic grades.

The community service and allied activities will be coordinated by the NSS/NCC/ Sports Coordinator or Technical / Cultural clubs of the Institute. The student will be provided a certificate from the concerned coordinator and Institutional Head. Every student is required to prepare a file containing documentary proofs of activities, done by him/ her. This file will be duly verified by the concerned evaluator. The student should earn the required activity points before he/she appears for his/her Final Examinations. The points students have earned will be reflected on the student's transcript. However, there will not be either grade/marks for these activity points nor will there be any effect on CGPA, etc.

Sl No.	Activity Heads	Documents and evidences	Evaluated by	Performance appraisal	Activity points
1	Inter/Intra institutional / Workshop /training	Certificate	Programme Coordinator	Satisfactory/Good/ Excellent	Participation: 10 Organization: 10
2	Working for consultancy / research project	Certificate	Principal Investigator	Satisfactory/Good /Excellent	20
3	Festival (Technical, Business, Cultural & others)	Certificate	Faculty In-charge / Principal	Satisfactory/Good / Excellent	Participation:10 Organisation:10
4	Contribution in Incubation /Innovation / Entrepreneurship cell/ Institutional Innovation Council	Certificate	Cell In-charge	Satisfactory/Good / Excellent	20
5	Participation in innovation related competition – Hackathons etc.	Certificate	Faculty Proctor	Satisfactory/Good / Excellent	20
6	Development of new product/business plan /registration of start-	Certificate	Faculty In charge	Satisfactory/Good / Excellent	40
7	Participation in all activities of Institute Ex. lPR workshop, leadership task, idea, design, innovation, business competition, technical Expos etc.	Certificate	Faculty Coordinator / Principal	Satisfactory/Good / Excellent	Participation: S Organisation: 5 5 marks for each activity subject to max. of 20.
8	Work experience at family business	Declaration by parent	TPO	Satisfactory/Good/ Excellent	20

9	Internship with industry, Govt, NGO,PSU,MSME Online internship	Detailed report	Faculty Proctor/ TPO / Industry Supervisor	Satisfactory/Good / Excellent	20-40 2 weeks: 20 4 weeks: 30 6 weeks: 40
10	Rural internship	Detailed report & Certificate	Faculty/ Proctor/ TPO / NCC/NSS Head	Satisfactory/Good / Excellent	20(Any on activity)

COURSE OUTCOMES: Students will

CO1: Explore career alternatives prior to graduation.
CO2: Assess interests and abilities in their field of study. Learn to appreciate work and its function in the economy.
CO3: Integrate theory and practice to Develop work habits and attitudes necessary for job success.
CO4: Develop communication, interpersonal and other critical skills in the job interview process.
CO5: Build a record of work experience. Acquire employment contacts leading directly to a full-time

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H				M					H		M
CO2	H		H			M		M				H
CO3	H	M			M		L				M	M
CO4	H		M		M	M		M	H			H
CO5	H			H			M			H		M

L – Low, M – Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP – 2021

<table>
<tr><td>Course Code</td><td colspan="2">21MEPC701</td><td colspan="3">B. Tech (Mechanical Engineering)</td><td colspan="2"></td></tr>
<tr><td>Category</td><td colspan="5">Professional Core</td><td colspan="2">Semester: VII</td></tr>
<tr><td>Course title</td><td colspan="7">HEAT TRANSFER</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td></td><td rowspan="3">Total Hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td colspan="2">Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Learn the physical behavior of various modes of heat transfer like conduction, convection and radiation
2. Know the application of various experimental heat transfer correlations in engineering calculations.
3. Understand the thermal analysis and sizing of heat exchangers.
4. Understand the concepts of Radiation Heat Transfer.
5. Learn the concepts of boundary layer and its importance in convection phenomenon.

COURSE CONTENTS

UNIT – 1

Introduction: Modes of heat transfer-conduction, convection and radiation, Material properties of importance in heat transfer, Thermal conductivity, Specific heat capacity, Derivation of general three-dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems. **Conduction:** One dimensional conduction equation for plane wall, cylinder and sphere, Thermal contact resistance, Critical thickness of insulation, one dimensional heat conduction through composite plane wall, long cylinder, and sphere. **10 Hours**

UNIT –2

Heat transfer in extended surfaces: Derivation of heat transfer through rectangular fin: long fin, short fin with insulated tip and convective tip. Types of fins-Fin efficiency and effectiveness. Applications of pin-fins and other types of finned sections.

Transient conduction: Derivation the expression for lumped parameter analysis, -temperature distribution curve-instantaneous heat transfer, total heat transfer, Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere.

10 Hours

UNIT –3

Convective heat transfer: Principle of heat flow in fluids, heat transfer coefficient, overall heat transfer coefficient, Velocity boundary layer, Thermal Boundary layer, drag coefficient, Significance of Reynold number, Prandtl number, Grashoff Number, Stanton Number, Nusselt number. **Natural convection:** Empirical correlations for flow around flat vertical plate, horizontal flat surface, horizontal cylinder. **Forced convection internal flow:** Laminar flow, Turbulent flow, thermal entrance region, full developed flow, Empirical correlations for flow through pipe. **10 Hours**

UNIT –4

Radiation heat transfer: Basic Definitions-Thermal radiation, Emissive power, radiosity, irradiation, absorptivity, reflectivity, Transmissivity, black body and grey body, Basic laws: Planck's law, Wein's law, Stefan-Boltzman law, Kirchoff's law and Lambert's cosine law, Radiation heat exchange between two parallel infinite black surfaces, two parallel infinite gray surfaces and View factor algebra; Infinite long concentric cylinders, small body in a large enclosure. **Heat exchangers:** Thermal design of heat exchangers, overall heat transfer coefficient, fouling and fouling factor, Temperature profile of heat exchangers, Log Mean Temperature Difference (LMTD): parallel & counter flow, LMTD correction factor, heat transfer effectiveness-NTU methods of analysis of heat exchangers, Boiling and Condensation in heat Transfer. **10 Hours**

UNIT –5

Numerical methods: Limitations, better modeling, flexibility, complications, human nature, Finite Difference Formulation of differential equations,1-D steady state heat conduction, Boundary conductions, 2-D steady state heat conduction, Boundary nodes, irregular boundaries. **Cooling in electronic equipment:** Introduction and History, Manufacturing of Electronic Equipment-The Chip Carrier, Printed Circuit Boards, Cooling Load of Electronic Equipment, Thermal Environment, Electronics Cooling in Different Applications, Conduction Cooling. **10 Hours**

TEXT BOOKS

1. Heat transfer, a practical approach, Yunus A- Cengel, 5th Edition, Tata Mc Graw Hill
2. Heat transfer, P.K. Nag, Tata Mc Graw Hill 2007
3. A Textbook on Heat Transfer, Sukhatme S P
4. Fundamentals Heat and Mass Transfer by K N Seetharamu, T R Seetharam,Wiley India Pvt Ltd 1 January 2012.

REFERENCE BOOKS

1. Fundamentals of heat and mass transfer, Frank P. Incropera and David P. Dewitt, John Wiley and Son's
2. Heat transfer-A basic approach, Ozisik, Tata Mc Graw Hill 2002
3. Heat Transfer, Holman, Mc Graw Hill.

EBOOKS/ ONLINE RESOURCES

1. A Text book of Heat Transfer, John H Lienhard, 4th Edition,
2. NPTEL Heat Transfer course for Mechanical Engineering, http://nptel.ac.in/courses/112101097/
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com

MOOC's

1. Fluid flow, Heat and Mass Transfer- http://ocw.tudelft.nl/courses/applied-earthsciences/fluid-flow-heat-mass-transfer/course
2. Heat transfer course- https://legacy.saylor.org/me204/Intro/

COURSE OUTCOMES: Students will

CO1 Identify the mode of heat transfer.
CO2 Apply principles of heat transfer to thermal systems.
CO3 Analyze conduction heat transfer phenomenon for transient processes.
CO4 Determine convective heat transfer for free and forced convection.
CO5 Formulate the heat transfer process in heat exchangers for parallel and counter flow arrangement.

SCHEME OF EXAMINATION

CIE – 50 Marks			
UNIT 1, 2 & 3		UNIT 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE – 20*5 = 100 Marks (To be scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions: 2 ✓ Maximum number of sub questions: 3 • Each full question shall be for a maximum of 20 Marks. • Answer any Five full question choosing at least One question from each unit.			

CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	L	L				M					H
CO2	H	M										M
CO3	M	H	L									H
CO4	H	L					H					M
CO5	M	M										H

L – Low, M – Medium, H – High L

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus –CBCS & NEP -2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702A</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">ENERGY RESOURCES AND POWER PLANT ENGINEERING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Identify the types of power plants and understand the functioning of hydel and nuclear power plants.
2. Understand the role of renewable energy sources
3. Demonstrate the concept of solar, wind and bio-mass energy utilization.
4. Analyze and design the solar, wind and bio-mass energy system or power plants
5. Emphasize the technology to replace the non-renewable energy sources by solar, wind and biomass energy sources.

COURSE CONTENT

UNIT – 1

Hydro-Electric Power Plant: Layout of Hydro-electric Power Plant- Dam, Water way, Penstock, Forebay, Intake structure, Trash rack, Surge Tank, Power House. Selection of site for a dam, Comparison of Thermal and Hydroelectric Power Cost. Types of Hydropower Power Plants, low head, medium head and high head hydel power plants. Run-of-river Plants, Pumped storage Plants, Base-load Plants, Peak – Load Plants, Connected Load, Maximum Demand, Demand Factor, Load curve, load factor, Plant-use Factor, capacity factor, diversity factor, peak load. Numerical problems.

10 Hours

UNIT – 2

Nuclear Power Plants : Fission and Fusion reaction, nuclear power plant and its layout, salient features of a nuclear reactor, types of reactors, boiling water reactors, pressurized water reactor, CANDU reactors.

10 Hours

UNIT – 3

Introduction to Energy sources: Energy sources and their availability, Conventional and non-conventional energy source, prospects of non-conventional energy sources.

Solar energy: Solar radiation and its measurements, solar radiation geometry, solar radiation data, average solar radiation on flat surface, solar radiation on a tilted surface. Numerical problems.

Solar collectors: Principle of conversion of solar energy to heat, Flat plate collectors and its Configuration, collector performance, absorbers, selective coating. Concentrating collectors and its classification, comparison between flat plate and concentrating collectors.

10 Hours

UNIT – 4

Solar energy applications: Solar water heating, space heating, space cooling, solar thermal electric conversion, solar electric power generation, agriculture and industrial process heat, distillation, solar pump, solar furnace, solar green houses, hydrogen generation.

10 Hours

UNIT – 5

Wind energy: Introduction, Principles of energy conversion system, wind data and energy estimation, site selection, basic components of the system, classification, advantages and disadvantages of wind energy conversion systems, horizontal and vertical axis machines, application of wind energy.

Energy from bio-mass: Bio-mass conversion, bio-gas generation, factors affecting the gas generation, classification of bio-gas plants, advantages and disadvantages. Constructional details of KVIC and Janata model, community bio gas plants, raw materials used, digester design, fuel properties of bio gas, utilization of bio gas, energy plantation, bio mass gasification, classification of gasifiers, application of the gasifiers.

10 Hours

TEXT BOOKS:

1. Power Plant Engineering, P. K. Nag Tata McGraw Hill 4thEd. 2017 ISBN: 9789339204044
2. Power Plant Engineering: Domakundawar, DhanpathRai sons. 8th Ed. 2016 ISBN:9788177001952

REFERENCE BOOKS:

1. Power Plant Engineering, R. K. Rajput, Laxmi publication, New Delhi. 5th Ed. 2016 ISBN:9788131802557
2. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill. 1991 2nd Ed. ISBN:9780071009911
3. Non-conventional Energy sources, G D Rai, Khanna Publishers. 5th Ed. ISBN:9788174090737
4. Non-conventional resources: B H Khan TMH – 2016 3rd Ed. ISBN:9789352601882

EBOOKS / ONLINE RESOURCES

1. Black & Veatch, “Power plant Engineering”, CBS Publisher, 2005
2. El-Wakil, M.M., “Power plant Technology”, McGraw-Hill Book Co, 2002
3. Potter, P.J., “Power Plant Theory & Design”, Kreiger Publishing Co., 1994

MOOCs

1. https://youtu.be/tYBg-zsli98
2. https://youtu.be/D0i1E_lE_TE

COURSE OUTCOMES: Students will

CO1: Analyze the role of nuclear and hydel power plants.

CO2: Emphasis the necessity of renewable energy sources.

CO3: Highlight the necessity of solar, wind and bio-mass energy.

CO4: Illustrate the design and development of solar, wind power plant and bio-mass energy power plant.

CO5: Apply the concept of solar, wind and bio-mass energy system to save the non-renewable energy sources.

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE – 50 Marks</td></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE – 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M		M	M		M			M		
CO2	M	H		H	H		H					
CO3	H				M		L					
CO4	L				L		H			H		
CO5	H		H	H	M		M					

L – Low, M – Medium, H - High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702B</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="4">Professional Elective-II</td><td colspan="2">Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">MECHATRONICS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. To understand over view of Mechatronics Systems
2. To Analyse the working of various components of Mechatronics system for various Applications
3. To study the different types of amplifying devices and data acquisition systems
4. To examine the Dynamics of a Mechatronics System and to Analyse the Interfacing of Microcontroller, Sensors and Actuators
5. To understand the Micro Fabrication Processes and fault finding

COURSE CONTENT

UNIT – 1

Definition and Introduction to Mechatronics Systems, Overview of Mechatronics products and their functioning, measurement systems, Control Systems, simple Controllers, Integrated Design Issues in Mechatronics, Mechatronics Design Process, Key Elements of Mechatronics system. Mathematical models, mechanical system building blocks, electrical system building blocks, thermal system building blocks, pneumatic systems build blocks. Electro-mechanical systems, hydro-mechanical systems. **08Hours**

UNIT – 2

Introduction Sensors, Sensors for Motion and Position Measurement, Proximity sensors, Electrical strain and stress measurement, Force measurement, Vibration—Acceleration Sensors, Time of flight sensors, Binary force sensors, Temperature measurement, Sensors for Flow Measurement, Pressure measurement, Problems, Introduction to Actuators, Electromagnetic Principles, Solenoids and Relays, Electric Motors, DC Motors, Permanent Magnet DC Motor, Dynamic Equations, Electronic Control of a Permanent Magnet DC Motor, The servo motor, Stepper Motors, Selecting a Motor, Hydraulics, Hydraulic Valves, Hydraulic Actuators, Pneumatics. **12Hours**

UNIT – 3

Introduction to Signal Conditioning, Amplifiers, ideal operational amplifier model, inverting amplifier, non-inverting amplifier, unity-gain buffer summing amplifier, difference amplifier, instrumentation amplifier, integrator amplifier, differentiator amplifier, comparator, sample and hold amplifier, active filters, Problems, Data acquisition, Introduction, Sampling and aliasing, Quantization theory, Digital-to-analog conversion hardware, Analog-to-digital conversion hardware, Problems, Protection, Filtering, Wheatstone Bridge, Digital signals, Multiplexers, Data Acquisition systems. **07 Hours**

UNIT – 4

Interfacing microcontrollers with actuators, Interfacing with general-purpose three-state transistors, Interfacing relays,, Interfacing solenoids Interfacing stepper motors, Interfacing permanent magnet motors, Interfacing sensors, Interfacing with a DAC, Interfacing power supplies, Interfacing with RS 232 and RS 485, Compatibility at an interface, Problems.

Modelling in the frequency domain, Modelling in the time domain, Converting a transfer function to state space, Converting a state-space representation to a transfer function, Block diagrams, Problems.

Introduction System response, Dynamic characteristics of a control system Zero-order systems First-order systems Second-order systems General second-order transfer function Systems modeling and interdisciplinary analogies Stability The Routh-Hurwitz stability criterion Steady-state errors, Problems. **14 Hours**

UNIT – 5

Introduction to Micro-fabrication, Photolithography, Ion implantation, Diffusion, Oxidation Chemical vapour deposition, Physical vapour deposition (Sputtering), Deposition by expitaxy, Etching. Bulk micro-manufacturing, Surface micro-machining, LIGA process. Fault Finding, Design for manufacturing, Practical Case Studies. **09 Hours**

TEXT BOOKS

1. Mechatronics - W. Bolton, 2nd edition, Addison Wesley Longman, 1999
2.Mechatronics - HMT, Tata McGraw-Hill Education, 1998

REFERENCE BOOKS

1.Introduction to Mechatronics & Measurement Systems- Michel B. Histand and David. Alciatore, McGraw Hill, 2002.
2.Understanding Electro-Mechanical Engineering an Introduction to Mechatronics -Lawrence J. Kamm, Wiley-IEEE Press, 1st edition, 1996.
3.Mechatronics System Design - Devdas Shetty and Richard A. Kolk, Cengage Learning, 2nd edition, 2011.
4.Mechatronics - Mahalik, Tata McGraw-Hill Education, 2003.

EBOOKS / ONLINE RESOURCES

1. https://www.mechatronic.me/2021/02/intro-to-mechatronics-e-book

2. https://Mechatronics-Electronic-mechanical-electrical-engineering-ebook/dp

MOOCs

1. https://onlinecourses.nptel.ac.in/noc21_me27/preview
2. https://alison.com/course/an-introduction-to-mechatronic-systems
3. https://www.srmist.edu.in/department-of-mechatronics/online-course

COURSE OUTCOMES: Students will

CO1: To develop the Mechatronics Systems in various applications.
CO2: To use the various components of Mechatronic systems and their Circuits.
CO3: To analyse the amplifying devices and data acquisition systems.
CO4: To Interface the Microcontroller, Sensors, Actuators and the System Models and to recognize the Dynamics of a Mechatronics System
CO5: To apply the Micro Fabrication Processes in practical case studies and identify the faults in the Mechatronic Systems.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	H							M			H	
CO2	H	M			M							
CO3	H	H						H			H	
CO4	H			M								
CO5	H							M			M	

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="5">21MEPE702C</td><td colspan="2">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="6">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="7">AUTOMATION IN MANUFACTURING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td colspan="2"></td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td colspan="2">Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td colspan="2">3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="3">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="8">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand the basic terminologies and concepts associated with Automation.
2. Understand the principles of Material Handling and Storage system equipment.
3. Analyze and Evaluate concepts Pneumatics to build the control circuits for Industrial Application.
4. Analyze and Evaluate concepts Electro-Pneumatics and Programmable Logic Controllers to build the control circuits for Industrial Application.
5. Create an Automated system using concepts of Programmable Logic Controllers to interface with Electro- Pneumatics.

COURSE CONTENTS

UNIT-1

Introduction to Automation

Automation-Definition, Reasons, Arguments for and against Automation. Automation and Control strategies, Basic elements of Automated system, Advanced Automation Functions-Safety monitoring, Maintenance & Repair diagnostics, Error Detection and Recovery, Level of Automation, Sensors, Actuators and other Control System components.

Production Operations & Automation strategies-Manufacturing Industries, Types of Production, Functions in Manufacturing, Information Processing in Manufacturing, Plant layout, Production concepts & Mathematical models – Problems.

12 Hours

UNIT-2

Automated Material Handling & Storage system

Principles of Material Handling Equipment's, Automated Guided Vehicle systems-Components, Types, Guidance, Routing, Steering, Control, Loading, System design, Advantage & Applications. Automated Storage & Retrieval systems-Definition of ASRS, functions, components, Types & Design of ASRS, Distributed Control structure for AGVs & ASRS, Conveyors, and Problems. **10 Hours**

UNIT- 3

Pneumatics in Automation

Industrial Prime movers, Basics of Pneumatics, Compressed Air-generation & Contamination control, Pneumatic Actuators, Pneumatic Valves & Control Circuits. Building of Pneumatic Circuits for typical Automation applications**.**

10 Hours

UNIT-4

Electro Pneumatics in Automation

Electro Pneumatics-Integration of Technologies, Solenoid valves, Control Devices-Switches, Push button, Relays, Sensors. Time delay relays (Timers). Building of Electro pneumatic circuits for typical Automation applications**.** **10 Hours**.

UNIT- 5

Programmable Logic Controllers in Automation

Discrete Process Control- Logic Control & Sequencing, Ladder Logic Diagrams, Programmable Logic Controller- Components of PLC, operating cycle, Capabilities and Programming PLC, Interfacing Electro Pneumatics with PLC.

08 Hours

TEXT BOOKS :

1. Mikell P Groover- Automation, Production systems and Computer Integrated Manufacturing, PHI Publishers 2002 and 1997.
2. Nanua Singh-Systems Approach to Computer Integrated Design and Manufacturing, John Wiley & Sons. Inc, New York 1996.
3. Joji P.-Pneumatic Controls. Wiley India Pvt Ltd edition 2008.

REFERENCE BOOKS

1. Hasebrink J.P ., and Kobler R., ―Fundamentals of Pneumatics/Electropeumatics‖, FESTO Didactic publication No. 7301, Esslingen Germany, 1979.
2. Ackermann et al., Programmable logic controllers –Advanced level, Festo Didactic KG, 1991
3. J.R. Hackworth and F.D. Hackworth, Jr., Programmable logic controllers-Programming methods and applications, Pearson Education, Prentice hall.

EBOOKS / ONLINE RESOURCES

1. https://www.amazon.in/Industrial-Automation-Hands-Frank-Lamb- ebook/dp /B00C4BDRSU
2. https://mhebooklibrary.com/doi/book/10.1036/9780071816472/ Industrial Automation: Hands On - McGraw-Hill eBook Library.
3.https://www.wiley.com/en-aw/Handbook of Design, Manufacturing and Automation-p-9780470172452

MOOCs

1.**Automation in Manufacturing By Prof. Shrikrishna N. Joshi, IIT Guwahati** https://onlinecourses.nptel.ac.in/noc22_me123/preview

2. https://www.classcentral.com/course/swayam-manufacturing-automation-14180

3.**https://www.classcentral.com/course/swayam-automation-in-production-systems-and-management-43561**

COURSE OUTCOMES: Students will

CO1: Describe the constructional features of Automation, Material Handling and storage System.
CO2: Implement the features of Pneumatics, PLC and Electro-Pneumatics system.
CO3: Solve the problems related to design of AGVS and storage system.
CO4: Simulate and Validate the Pneumatics control circuit built for various industrial Applications.
CO5: Design an Electro-Pneumatics circuit interfaced with PLC for typical industrial Applications.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	H		H					M			M	
CO2	H			M		M	M					
CO3	H	H			M					H		
CO4	H				M							
CO5	H		H								M	

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702D</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">PRODUCTION AND OPERATION MANAGEMENT</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. To study the fundamentals of production and operations management.
2. To know how various models can be applied for achieving solutions.
3. Understanding concepts of practical application of operations management using Audio and video presentations.
4. Students will come to understand the latest operations models by reference books and lectures will cover by students will be made to refer latest research publications.
5. To prepare the students to ever changing job market like industry, research, higher education and teaching.

UNIT-1

Introduction to POM: Historical evolution of POM, the system concept, system efficiencies and effectiveness, decision making for POM systems, role of models, the internal & external environment of POM, concepts of production and the measurement**.**
Designing of the POM systems: Output design, materials & processing considerations, design specifications and tolerances, standardization & interchangeability, human engineering
Facility design: Layout types, functional & product type's layouts, fixed position layout, cellar layouts, line balancing, new manufacturing methods, problems

10 Hours

UNIT-2

Operation standards and work measurements: Job design, production and operations standards, work measurement techniques **Capacity** planning: Capacity planning decisions, capacity planning models, decision tree analysis and break-even analysis, problem **10 Hours**

UNIT-3

Location analysis: Location factors, Industrial plant locations, models for single facility and multi- facility locations, transportation model, and simple median model problems. Forecasting: Requirements of forecasting for operations, categories of forecasting methods, moving averaging method, exponential smoothing with trend and seasonality, forecasting errors, regression analysis, delphi method, problems.
Aggregate planning: Aggregate planning costs, the goals of aggregate planning, strategies for developing aggregate planning, mathematical models, aggregate planning by linear programming approach (transportation model) problems. **10Hours**

UNIT- 4

Introduction, Bayesian analysis, value engineering, purchasing research, vendor relations, negotiations, price forecasting, forward buying, make or buy.
Inventory control: Introduction, demand and control system characteristics, inventory concepts and systems, costs, modelling. Inventory types, Inventory costs, ABC's of inventory, EOQ models with and without shortage, production Inventory model, inventory model with price break, problems

10 Hours

UNIT- 5

Operation Scheduling: Job shop scheduling, scheduling for batches, high volume continues systems, scheduling for service systems. Materials requirement planning: Planning for material needs, capacity planning, limitations and advantages of MRP, Manufacturing Resource Planning (MRP-II), Just-In-Time (JIT) manufacturing. Software tools and case studies.

10 Hours

TEXT BOOKS

1. Production and Operations Management, Models & Behavior, 5th edition, Everett Adam, Jr. Ronald J Ebert, Prentice Hall India Publications.
2. Production and Operations Management, Chary, 3rd Edition Mc Graw Hill Publications.

REFERENCE BOOKS

1. Production and operation management By Adam & EBERT
2. Modern Production Operation Management By BUFFA
3. Operation Management by Joseph Monks
4. Production & Operation Management by S. N. Chary.

E BOOKS

1.https://www.amazon.in/PRODUCTION-OPERATIONS-MANAGEMENT-Anil-Karanjakar-ebook/dp/B07KRWDBRJ
2.https://www.amazon.in/Production-Operations-Management-P-L-Verma-ebook/dp/B01M0E4OXB

MOOC

https://youtu.be/CYoMGVJk_2s
https://youtu.be/Hcjoh92gr1A

COURSE OUTCOMES: Students will

CO1: The **students** this course will elective subject for BTech in Mechanical Engineering.
CO2: The students will study using a text book and reference books, class lectures, audio and video presentation by the faculty.

CO3: By **the** end of semester, he would gain insight into latest production techniques used by large corporations.

CO4: The **teaching** and learning process will be tested by use of Quiz, Tests, Paper Presentation, Final Examinations.

CO5: The **students** get prepared for the challenges he will face after the course completion.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any *Five* full questions choosing at least One question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	L				M						H
CO2	L	H	L									H
CO3	L	L				H						L
CO4	H	H	L									H
CO5	L	L				M						L

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702E</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">ADDITIVE MANUFACTURING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand the basics of additive manufacturing.
2. Analyze the Powder based and Deposition based additive manufacturing processes.
3. Analyze photo polymerization ink jet binders and laser engineered net shaping processes.
4. Evaluate different tooling processes of additive manufacturing.
5. Create a model for selection of AM process for different application.

UNIT-1

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM. Classification and types of AM.

AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing. **10Hours**

UNIT-2

Powder Bed Fusion Processes: Introduction, Materials, Powder Fusion Mechanisms, Process Parameters and Modeling, Laser, UV and IR; Process Benefits and Drawbacks. Extrusion Based Systems: Introduction, Basic Principles, Plotting and Path Control, Fused Deposition Modeling**.**

10 Hours

UNIT-3

Stereo lithography: Materials, Process parameters, advantages and limitations;

Material and Binder Jetting: Evolution, Materials, Material Processing Fundamentals, Material Jetting Machines, Process Benefits, binding materials and systems.

Laser Engineered Net Shaping (LENS): Materials, Process Parameters & System Post Processing of additive manufactured parts.

10 Hours

UNIT-4

Rapid Tooling: Introduction, Direct and Indirect tooling process; Production of Injection Moulding Inserts, EDM Electrodes, Investment Casting and other Systems, RTV Silicone Tooling, Calcium silicate based castable tooling. Case Studies. **10 Hours**

UNIT-5

Design for Additive Manufacturing: Design for Manufacturing and Assembly, AM Unique capabilities, Core DFAM Concepts and Objectives, CAD Tools for AM

AM Applications: Introduction, The use of Additive Manufacturing in Aerospace, defence, automobile, Bio-medical and general engineering industries. Case studies. **10 Hours**

TEXT BOOKS

1. Dr. Ian Gibson, Dr. Brent Stucker, Dr. David W. Rosen, Additive Manufacturing Technologies-Rapid Prototyping to Direct Digital Manufacturing, Publisher: Springer;2010 edition
2. Chee Kai Chua- Kah Fai Leong- Chu Sing Lim, "Rapid prototyping- principles and applications" WSPC; 3 edition.
3. Amit Bandyopadhyay,Susmita Bose, "Additive Manufacturing", CRC Press 2015.
4. K S Badrinath, Hari Prasad, "Rapid Prototyping and Tooling" , Publisher: Page Turners, ISBN-13 : 9788192320656.

REFERENCE BOOKS

1 N. Hopkinson, R.J.M. Hague and P.M. Dickens, "Rapid Manufacturing, An Industrial Revolution for the Digital Age" John Wiley & Sons, Ltd, 2006 edition.

EBOOKS / ONLINE RESOURCES

1. https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf .
2. https://www.mdpi.com/books/book/462-additive-manufacturing-technologies-and-applications .

MOOCs

1. https://nptel.ac.in/courses/112/103/112103306/ .

COURSE OUTCOMES: Student will

CO1: Describe the importance of steps involved in the quality of the components produced using additive manufacturing.
CO2: Compare and select suitable powder or deposition based. Process for particular application.
CO3: Distinguish between various additive manufacturing processes in respect of photo Polymerization based and ink jet binder.
CO4: Assess the different tooling process of additive manufacturing.
CO5: Develop and formulate a model for application of additive manufacturing technology in aerospace, defense and medical fields

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	H				H		L					L
CO2	L											
CO3	M											
CO4			M		M		M					M
CO5			M							M		M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="2">21MEPE702F</td><td colspan="4">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">MODERN METHODS OF MANUFACTURING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand and apply the different Additive Manufacturing Processes.
2. Apply and evaluate the various aspects of Additive Manufacturing.
3. Evaluate the capabilities of Hybrid Electro chemical machining Nontraditional Machining Processes.
4. Analyze the different Hybrid thermal Nontraditional Machining Processes.
5. Apply the various design principles and enabling technologies to model smart manufacturing systems.

UNIT-1

Additive Manufacturing (AM)

Introduction, Basic concepts, AM process chain, classification. Principles of working, Process description, Capabilities and limitations of Photopolymer based, Extrusion based and lamination based AM. AM Processes with examples: Stereo lithography, Solid Ground Curing (SGC), Selective laser Sintering (SLS), Polyjet printing, Fused Deposition modelling (FDM), Laminated object Manufacturing (LOM), Laser Engineered Net Shaping (LENS). **10 Hours**

UNIT-2

Rapid Tooling, Design for AM and Case Studies

Rapid Tooling -Introduction, Direct and Indirect Tooling, Production of injection moulding inserts, EDM electrodes, Investment casting parts, Silicone Rubber tooling, Composite tooling, Calcium silicate based castable tooling. Design for Manufacturing and Assembly, AM unique capabilities, Core DFAM concepts and objectives, AM Process optimization. Case studies of AM in Aerospace, Defense, Automobile, Biomedical and General engineering industries.

10 Hours

UNIT-3

Hybrid Non Traditional Machining Processes

Introduction, Principle of material removal, Process description, capabilities and applications of Hybrid Electro Chemical Processes - Electrochemical Grinding, Honing and super finishing. Ultrasonic assisted Electrochemical machining (ECM) and Laser assisted ECM. **10 Hours**

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UNIT-4

Thermal Processes – Electro Erosion Dissolution Machining, Electro Discharge Grinding, Abrasive Electro Discharge Machining, EDM with Ultrasonic assistance and Electro chemical Discharge Grinding. **10 Hours**

UNIT-5

Smart manufacturing: Industry 4.0 and Smart Manufacturing-Meaning, General Concept, Components, Design Principles and Enabling Technologies, case studies. **10 Hours**

TEXT BOOKS

1 Dr. Ian Gibson, Dr. Brent Stucker, Dr. David W. Rosen, Additive Manufacturing Technologies-Rapid Prototyping to Direct Digital Manufacturing, Publisher: Springer; 2010 edition

2 Chee Kai Chua- Kah Fai Leong- Chu Sing Lim, "Rapid prototyping- principles and applications" WSPC; 3 edition.

3 Amit Bandyopadhyay, Susmita Bose, "Additive Manufacturing", CRC Press 2015.

4 V. K. Jain, "Advanced Machining Processes", Allied Publishes Pvt Ltd, New Delhi.

5 Raj Kamal, "Internet of Things" McGraw Hill Education (India) Pvt Ltd.

6 Kalpak Jain. "manufacturing process for engineering materials" 5th Edition, ISBN: 9780132272711 Pearson Education, inc.,Prentice Hall 2008

7 E. Paul Degarmo, J. J. Black and Ronald A Kosher, "Material and Processes in Manufacturing", 11th Edition John Wiley and Sons, 2011. ISBN-10 0470924675 ISBN-13 978-0470924679.

8 Andrew Kusaik, "Intelligent Manufacturing System", Englewood cliffs, NJ, Prentice Hall, 1990.

REFERENCE BOOKS

1 N. Hopkinson, R.J.M. Hague and P.M. Dickens, "Rapid Manufacturing, An Industrial Revolution for the Digital Age" John Wiley & Sons, Ltd, 2006 edition.

2 Hassan El Hofy, "Advanced Machining Processes" McGraw Hill, 2005.

EBOOKS / ONLINE RESOURCES

1 https://fcusd.org/cms/lib/CA01001934/Centricity/Domain/4529/Fundamentals%20of%20Modern%20Manufacturing%20Materials%20%20Processes%20and%20Systems%20%204th%20Edition.pdf .

2 https://e-library.toyota.co.id/e-lib/repository?Modern-Manufacturing-Engineering.pdf .

MOOCs

1 https://nptel.ac.in/courses/112107078 .

COURSE OUTCOMES: Students will

CO1: Describe and compare the capabilities of different Additive Manufacturing Processes.
CO2: Select an appropriate process and parameters for producing parts used in Biomedical, Aerospace, and Defense Industries.
CO3: Select a suitable Electro chemical Hybrid Non-Traditional Machining Process for a given situation.
CO4: Select a suitable hybrid thermal non-traditional machining process for given situation.
CO5: Develop and illustrate a typical smart manufacturing system.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *five* full questions choosing at least one full question from each unit.			

CO-GA MAPPING

	GA1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	H				M		M			M		H
CO2		H			M							H
CO3	H											
CO4	M						H			M		L
CO5	H			M					L	M		M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS &NEP- 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702G</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">AUTOMOBILE ENGINEERING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1 Identify the different parts of the automobile
2 Explain the working of various parts like engine, transmission, clutch, brakes
3 Describe how the steering and the suspension systems operate.
4 Understand the environmental implications of automobile emissions
5 Develop a strong base for understanding future developments in the automobile industry

COURSE CONTENT

UNIT – 1

Introduction: Vehicle Structure and Engines-Types of Automobiles, Vehicle Construction – Chassis, Frame and Body, Aerodynamics, Components of Engine – Their forms, Functions and Materials, Review of Cooling and Lubrication systems in Engine, Turbo Chargers, Engine Emission Control, Electronic Engine Management System.

10 Hours

UNIT –2

Vehicle performance: Resistance, power and torque curve, driving force against vehicle speed, acceleration and grade-ability in different gears for a typical car or truck plotted from specifications. Calculation and plotting the curves of air, rolling and gradient resistances, driving force, engine power, speed, rear axle ratio. Torque and mechanical efficiency at different vehicle speeds. **10 Hours**

UNIT –3

Engine basic theory: Engine types and their operation, classification, Properties of I.C. engine fuels, combustion phenomenon, two stroke engines, four stroke engine, characteristics of engines, valve timing diagram. Transmission Systems-Clutch – Types and Construction, Gear Boxes-Manual and Automatic, Over Drives, Transfer Box Fluid flywheel-Torque convertors, Propeller shaft – Slip Joint – Universal Joints, Differential and Rear Axle, Hotchkiss Drive and Torque Tube Drives. **10 Hours**

UNIT –4

Propeller shaft and final drive: Functional and design characteristics of propeller shaft, selection criteria for material and cross section of propeller shaft, need for differential and final drive. WHEELS AND TYRES: Use of different types of wheels and tyres, specification, materials. STEERING AND SUSPENSION: Effort multiplication and geometry in steering, types of springs used in suspension system, need for damping. BRAKES: Distribution of braking force on front and rear wheels, stopping distance and braking efficiency, introduction to ABS. **10 Hours**

UNIT –5

Electrical and electronic systems: Application of electricity in automobiles, starting, charging, lighting and accessory systems. Application of basic electronic components in automobiles**. Alternate energy and propulsion systems:** Introduction to alternate fuels – LPG, CNG, Bio fuels, Alcohol fuels. Introduction to electric, hybrid and fuel cell vehicles. **10 Hours**

TEXT BOOKS

1. W H & Anglin D L, "Automotive Mechanics", Tata McGraw Hill Publishing Company, 2004.
2. Robert Bosch "Automotive Hand book", 5th edition, 2004.
3. Ganesan V , "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 2003.
4. Mathur L and Sharma R P, "Internal Combustion Engines", Dhanpat Rai Publications (P), Ltd, New Delhi, 2002.

REFERENCES BOOKS

1. Heinz Heisler, "Advanced Engine Technology", SAE 1995.
2. Richard Stone, "Introduction to IC Engines", 2nd edition, Macmilan,1992.
3. Obert E F, "Internal Combustion Engine analysis and Practice ", International Text Book Co., Scranton, Pennsylvania, 1988.
4. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill International Editions, 1988.

E-BOOKS / WEB REFERENCES

1. http://nptel.ac.in/courses/112104113/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112105123/

MOOCs:

1. https://www.coursera.org/course/introthermodynamics
2. https://www.iitbombayx.in/courses/IITBombayX/ME209xA15/2015_T1/about

COURSE OUTCOMES: Students will

CO1 Understand the construction and functions of components of IC engine, different engine systems and transmission systems used in IC engines and
CO2 Propeller shaft and final drive systems, use of basic electronic components in automobiles. Alternate energy and propulsion systems.
CO3 Estimate Vehicle performance parameters.
CO4 Compare different transmission systems, tyres, wheels, suspension systems and brakes.
CO5 Analyze braking systems for their performance.

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE – 50 Marks</td></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE – 20*5 = 100 Marks
(To be scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions: 2
✓ Maximum number of sub questions: 3
• Each full question shall be for a maximum of 20 Marks.
• Answer any Five full question choosing at least One full question from each unit.</td></tr>
</table>

CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M										H
CO2	M	M	L				M					H
CO3	H	H	L						H			M
CO4	M	H					M					H
CO5	H	M										H

L – Low, M – Medium, H – High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS &NEP- 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE702H</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">COMPOSITE MATERIALS TECHNOLOGY</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Identify the Composites and its classification to the field of Engineering.
2. Understand the strength and weaknesses of a given class of Polymer Matrix Composites.
3. Examine the strength and weaknesses of a given class of Metal Matrix Composites.
4. Define the strength and weaknesses of a given class of Ceramic Matrix Composites
5. Integration of the Composites as a building engineering technology.

UNIT- 1

Fundamentals Of Composites: need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. Advantages and application of composites. Matrix And Reinforcement: Types of matrix and reinforcement, volume fraction and weight fraction, Fiber architecture, fiber packing arrangements, whiskers, Behaviour of unidirectional composites, law of mixtures and numerical problems **10 Hours**

UNIT – 2

Polymer Matrix Resins : Thermosetting resins, thermoplastic resins – Reinforcement fibres rovings, Woven fabrics, Non woven random mats, various types of fibres. Advantages and Limitations of PMC's. PMC processes: Hand lay-up processes, Spray up processes, Compression moulding, Reinforced reaction injection moulding, Resin transfer moulding, Pultrusion, Filament winding, Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GFRP). **10 Hours**

UNIT – 3

Processing Of Metal Matrix Composites: Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix, Reinforcements, particles, fibres. Effect of reinforcement: Volume fraction, Rule of mixtures. Processing of MMC, Powder metallurgy process, diffusion bonding, stir casting, squeeze casting, recycling of Metal Matrix Composites **10Hours**

UNIT – 4

Processing Of Ceramic Matrix Composites : Properties, advantages, limitations, Monolithic ceramics, Need for CMC, Ceramic matrix various types of Ceramic Matrix composites oxide ceramics, non oxide ceramics, aluminium oxide, silicon nitride, reinforcements, particles, fibres, whiskers. Processing of CMC: Sintering, Hot pressing, Cold isostatic pressing (CIPing), Hot isostatic pressing (HIPing). **10Hours**

UNIT – 5

Joining Methods and Failure Theories: Joining, advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

Nonconventional Composites: Introduction, Nanocomposites, Polymer clay nano-composites, self healing composites, self-reinforced composites. Biocomposites, Laminates; Ceramic Laminates, Hybrid Composites

Application & developments: Aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites.

10 Hours

TEXT BOOKS

1. Autar K. Kaw, Mechanics of Composite materials, CRC Taylor & Francis, 2nd Ed, 2005
2. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3Ed, 2012
3. Robert M. Jones, Mechanics of Composite Materials, Taylor & Francis, 1999.
4. Dr. H. K. Shivanand, "Composite materials", Asian publishers

REFERENCE BOOKS

1. Madhijit Mukhopadhay, Mechanics of Composite Materials & Structures, Universities Press, 2004
2. Michael W, Hyer, Stress analysis of fiber Reinforced Composite Materials, Mc-Graw Hill International, 2009
3. Fibre Reinforced Composites, P.C. Mallik, Marcel Decker, 1993
4. Hand Book of Composites, P.C. Mallik, Marcel Decker, 1993

EBOOKS / ONLINE RESOURCES

1. https://nptel.ac.in/courses/112104168
2. https://archive.nptel.ac.in/courses/101/104/101104010/
3. https://www.udemy.com/course/composite-materials/
4. https://www.coursera.org/lecture/material-behavior/1-6-composites-R1boo

MOOCs

1. https://nptel.ac.in/courses/101106038
2. https://archive.nptel.ac.in/courses/101/106/101106038/
3. https://www.udemy.com/course/composite-materials/
4. https://courseware.cutm.ac.in/?s=composite+materials

COURSE OUTCOMES: Students will

CO1: Knowledge about composites and its applications
CO2: Understand the various processing methods of polymer matrix composites
CO3: Enhance awareness on intricate knowledge on metal matrix composites
CO4: Familiarize with the basics of ceramic matrix composites processing
CO5: Knowledge on the recent advances in composites

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE –50 Marks</td></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
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✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M	L				L					M
CO2	H	H	L									M
CO3	H	H	L						H			M
CO4	H	H	L				M					M
CO5	H	H	H									M

L – Low, M – Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE703A</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-III</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">TOTAL QUALITY MANAGEMENT</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1 To study the fundamentals of quality management.

2 To know how various methods can be applied for achieving quality in manufacturing and service.

3 Understanding concepts of practical application of quality using audio and video presentations.

4 Students will come to understand the latest quality models by reference books and lectures will cover by students will be made to refer latest research publications.

5 To prepare the students to ever changing job market like industry, research, higher education and teaching.

UNIT-1

Introduction to TQM: The TQM axioms, Consequences of total quality, Costs of total quality, Tools for total quality. The Deeming Approach to Management: Historical background, Deming's 14 principles, Implementing Deming's Philosophy.
Juran's Approach to Quality: Developing quality, Quality trilogy, and Universal breakthrough sequence. Crosby's Approach to Quality: Diagnosis of a troubles company, Quality vaccine, Absolutes for quality management, fourteen steps for quality improvement management. The concept of kaizen: kaizen & innovation, Kaizen Management practices. **10 Hours**

UNIT-2

Technical Tools for Quality: Techniques for general use, Bar chart, Brain storming, Cause and effect analysis, QFD, Pareto analysis, cost benefit analysis, customer supplier relationship checklist, quality costing

Technical Tools for Quality: Techniques for quality control, Introduction, Data collection plan variable control chart (X & R) Process capability studies**.** **10 Hours**

UNIT-3

Attributes Control Chart: P &n P, C & U control charts, interpreting the control charts and their applications, case studies and problems

Aspects of Specification and Tolerance: statistical tolerance, precision predictability and accuracy. Probability distributions problems **10 Hours**

UNIT-4

Acceptance Sampling: Fundamental concepts, discrete and OC continuous distribution curves**,** AQL, LTPD, AOQL Sampling plans, Single, Double & multiple sampling plan. **10 Hours**

UNIT-5

Reliability: Definition, MTBF, Failure rate and reliability, calculation, reliability improvement, redundancy, reliability testing ISO 9000: Introduction, standards, benefits of ISO. Software tools and case studies. **10 Hours**

TEXT BOOKS

1. Managing for total quality - from Deeming to Taguchi's & SPC By N. Logothetis, PHI-EEE.
2. Statistical Quality Control - Eugene L, Grant and Richard S. Leaven worth Mc. Grew Hill.

REFERENCE BOOKS

1 TQM and ISO 14000 - Dr. K.C. Arora, S.K. Kataria & Sons
2 Total Quality Management - Hohn S. Oakland, Heinmann Professional Publishing.
3 Total Quality Management- Besterfield, Pearson's Pub.

E-BOOKS

1. https://upgrad.talentedge.com/advanced-general-management-programme-imt-ghaziabad/
2. https://www.nibmglobal.com/

MOOC

1. https://www.openlearning.com/courses/total-quality-management/
2. https://onlinecourses.nptel.ac.in/noc20_mg34/preview

COURSE OUTCOMES: Students will

CO1: Understand the fundamental principles of Total Quality Management
CO2: Choose appropriate statistical techniques for improving processes.
CO3: Develop research skills that will allow them to keep abreast of changes in the field of Total Quality Management.
CO4: Identify requirements of quality improvement programs.
CO5: To realize the importance of significance of quality.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H	L		M							
CO2	H	M	L		M				M			
CO3	M	L			H							
CO4	M	M			M			H		M		
CO5	M	M			M							

L – Low, M – Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE703B</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-III</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">SMART MATERIALS AND STRUCTURES</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Identify the smart materials, its classification.
2 Understand the strength and weaknesses of a given class of smart materials.
3 Apply of smart material to build smart systems.
4 Analyze Strengths and weaknesses of smart material in the design of a product.
5 Integration of smart materials as sensor and actuator to build smart systems.

UNIT- 1

Introduction: Characteristics of metals, polymers, ceramics and composite materials. Introduction to smart materials, need of Smart Materials and Structures, Classification of smart materials and structures. Sensing and actuation: Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation. Types of sensors and their applications, Smart composite materials, self-sensing and self-healing materials, smart devices, applications and problems **10Hours**

UNIT – 2

Piezoelectric materials, Properties, fabrication and types, piezoelectric constitutive relations, depoling and coercive field, field strain relation. Hysteresis, Creep and Strain rate effects, Inchworm Linear Motor, actuators for precision movement control. , Beam modeling with induced strain Rate effects single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Applications and problems.

Vibration Absorbers: Introduction, Parallel Damped Vibration Absorber, Analysis, Gyroscopic Vibration absorbers, analysis & experimental set up and observations, Active Vibration absorbers. Control of Structures: Introduction, Structures as control plants, Modelling structures for control, Control strategies and Limitations. **10Hours**

UNIT – 3

Introduction and classification of shape memory alloys and polymers, Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Influence of stress on characteristic temperatures, Modelling of shape memory effect, Vibration Control through SMA, Multiplexing. Applications and Problems. **10Hours**

UNIT – 4

Electro rheological (ER) and magneto rheological (MR) fluids: Mechanisms and properties, fluid composition and behavior, The Bingham Plastic and Related Models, Pre-Yield Response. Post-Yield flow, applications in Clutches and vibration dampers and others.
Dielectric elastomer, Electroactive materials, Thermoelectric materials, Photomechanical materials, Chromogenic material, Thermochromic, Photochromic, Piezochromic, Magnetochromic, Magnetostrictive and Functionally Graded Materials. **10Hours**

UNIT – 5

Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in crack detection, Elements of signal processing, Wearable smart materials, Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration, MEMS devices, Intelligent System Design, Emergent System Design **10Hours**

TEXT BOOKS

1. M. V. Gandhi and B. S. Thompson, Smart Materials and Structures, Chapman and Hall, London, New York, 1992 (ISBN: 0412370107).
2. B. Culshaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN: 0890066817).

REFERENCE BOOKS

1. A. V. Srinivasan and D Micheal Mcfarland, Smart Structures: Analysis and Design, Cambridge University Press, Cambridge, 2001
2. K. Uchino, Piezoelectric Actuators and ultrasonic Motors, Kluwer Academic Publishers, Boston, 1997 (ISBN: 0792398114).
3. Banks HT, RC Smith, Y Wang, Massow S A , Smart Materials and Structures, Wiley – Blackwell, ISBN-13: 978-0471970248

EBOOKS / ONLINE RESOURCES

1. https://www.researchgate.net/publication/281836834_Smart_Materials_and_Structures
2. https://www.ltrc.lsu.edu/pdf/report_375.pdf
3. https://www.sciencedirect.com/science/article/abs/pii/026130699290045J
4. https://www.worldscientific.com/doi/10.1142/9789812797360_0009

MOOCs

1. https://onlinecourses.nptel.ac.in/noc22_me17/preview
2. https://www.classcentral.com/course/swayam-smart-materials-and-intelligent-system-design-14288
3. https://www.iitk.ac.in/smss/post/swayam_noc21_me60/
4. https://courseware.cutm.ac.in/courses/10366/

COURSE OUTCOMES: Students will

CO1: Understanding smart materials and structures, its classification.
CO2: Describe and selection of smart materials.
CO3: Conduct experiments to verify the predictions of smart structures.
CO4: Validation on compatibility of smart structure & smart materials.
CO5: Design simple models for smart structures & materials.

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	M				M			M			
CO2												
CO3	H	H			M			M			H	
CO4		M										M
CO5	M	L				M	M		M			

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE703C</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-III</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">INDUSTRY 4.0</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand the concept of Industry 4.0 and its components.
2. Apply the concepts of Industry 4.0.
3. Analyse the various subsystems of Industry 4.0.
4. Apply the concepts of various technologies in designing of Industry 4.0 systems.
5. Design a typical Industry 4.0 system.

UNIT-1

Introduction to Industry 4.0: Definition of Industry 4.0, What it is all about and why do we have to change industrial production, Comparison of Industry 4.0 Factory and Today's Factory, The 10 most important things that will change with Industry 4.0, Difference between conventional automation and Industry 4.0, Basic principles and technologies of a Smart Factory: Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber-Physical Systems, Value chains in manufacturing companies, Customization of Products, Digital Twins, Cloud Computing / Cloud Manufacturing. **10 Hours**

UNIT-2

Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS): What are cyber-physical systems?, Definition: Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory and real time requirements, Communication in cyber-physical systems, Design methods for cyber-physical systems (Modeling, Programming, Model Integrated Development), Applications for cyber-physical systems (examples of existing or future applications in the field of Manufacturing, traffic, medical technology, etc **10 Hours**

UNIT-3

Assistance Systems for Production: The connected worker within the Industry 4.0 Scenario, Diversity-driven workplaces (barrier free workplaces, accessibility in production), Human-and Task centered assistance systems (eg. Motion capture system for training employees, etc.), Technical Tools ("Ambient Assisted Working" (AAW)), Mobile information technologies, Shop floor information systems, Production line support systems (pick by light, assembly display systems, assembly control by vision), Applications assistance systems in production (examples of existing or future applications in the field of Manufacturing). **10 Hours**

UNIT-4

Human-Robot Collaboration: Human-Robot Collaboration in Industry, Collaborative Robots, tasks, examples (Yumi, IIWA, UR, Panda), Types of Human-Robot Collaboration, Applications with Collaborative Robots (examples of existing or future applications in the field of Manufacturing).

Interoperability: Communication systems and standards for Industry 4.0, The Industry 4.0 Reference Architecture Model RAMI 4.0, Basics on service oriented Architecture, OPC-UA as future standard in Industry 4.0, Machine to machine interaction in practice (examples of existing or future applications in the field of Manufacturing).

Cloud Manufacturing and the connected factory: Virtualization, Cloud Platforms, Big data in Production, Cloud based ERP and MES solutions, Connected factory applications, Predictive Maintenance Data Visualization, Using a Cloud Development Environment to develop a Predictive Maintenance Tool for Manufacturing, Cloud development in practice (examples of existing or future applications in the field of Manufacturing). **10 Hours**

UNIT-5

Artificial Intelligence in Production: Machine Learning Application, Basics of Machine Learning, The Machine Learning Process, Machine Learning in practice (examples of existing or future applications in the field of Manufacturing).

Safety and Security in networked Production Environments: What means Safety with Industry 4.0, Safety for connected Machines and Systems, Safety in Human Robot Cooperation, How Industry 4.0 can optimize Safety, Security & Security Risks with Industry 4.0, Security and privacy risks in AI, Approach to Cyber-Physical Security in Industry 4.0.

10 Hours

TEXT BOOKS

1 Industry 4.0: Industrial Revolution of the 21st Century (Studies in Systems, Decision and Control Book 169) – Elena G. Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz, *Springer* (2019).

2The Fourth Industrial Revolution – Klaus Schwab, *Portfolio Penguin* (2018).

3. Industry 4.0 – The Industrial Internet of Things, Alasdair Gilchrist, *APRESS* (2016).
4. Industry 4.0: Managing The Digital Transformation – Alp Ustundag, Emre Cevikean, *Springer* (2017).
5. Enterprise IoT A Definite Handbook- Naveen Balani, *CreateSpace Independent Publishing Platform* (2016).

REFERENCE BOOKS

1 The Concept Industry 4.0 – An Empirical Analysis of Technologies and Applications in Production Logistics – Christoph Jan Bartodziej, *Springer Gabler* (2017).

2 Sustainable Manufacturing for Industry 4.0 : An Augmented Approach – K. Jayakrishna, K.E.K. Vimal, S. Aravind Raj, Asela K. Kulatunga, M.T.H. Sultan, J. Paulo Davim, *CRC Press* (2020).

3 Digitizing the Industry – Internet of Things connecting the Physical, Digital and Virtual Worlds – Oyidiu Vermesan, *River Publishers* (2016).

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EBOOKS / ONLINE RESOURCES

1 Introduction to Industrial Internet of Things and Industry 4.0 – Sudip Mishra, Chandana Roy, Anandarup Mukherjee, *CRC Press* (2020).
2 Handbook of Industry 4.0 and SMART Systems – Diego Galar Pascual, Pasquale Daponte, Uday Kumar, *CRC Press* (2019).
3 Digital Manufacturing and Assembly Systems in Industry 4.0 – Kaushik Kumar, Divya Zindani , J. Paulo Davim, *CRC Press* (2021).
4 Networking and Security in Industrial Automation Environments Design and Implementation Guide – *CISCO* (2021).

MOOCs

1 https://nptel.ac.in/courses/106105195 .

COURSE OUTCOMES: Students will

CO1: Understand the concept of Industry 4.0 and its components.
CO2: Apply the concepts of Industry 4.0.
CO3: Analyze the various subsystems of Industry 4.0.
CO4: Apply the concepts of various technologies in designing of Industry 4.0 systems.
CO5: Design a typical Industry 4.0 system.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			
There shall be 10 questions • Two full questions to be set from each unit with internal choice. ✓ Minimum number of sub questions : 2 ✓ Maximum number of sub questions : 3 • Each full question shall be for a maximum of 20 marks. • Answer any *Five* full questions choosing at least One full question from each unit.			

CO-GA MAPPING

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10	GA 11	GA 12
CO1	M							L				M
CO2	M									M		
CO3		M										
CO4			M		L							
CO5			M	M		L				L		M

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP – 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE703D</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Professional Elective-III</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">REFRIGERATION AND AIR-CONDITIONING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand the working principle of refrigeration cycles.
2. Evaluate the performance of the compressor systems.
3. Concept of Psychometry process and charts.
4. Design the refrigeration Based on the cooling load.
5. Understand the principle of air conditioning.

COURSE CONTENTS

UNIT – 1

Introduction to Refrigeration –Basic Definitions, ASHRAE Nomenclature, Joule Thompson coefficient and Inversion Temperature. **Refrigerants:** Types of Refrigerants, Selection of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Properties of refrigerants, Mixture Refrigerants - azeotropic mixtures.

10 Hours

UNIT –2

Refrigeration cycles: Evaporative refrigeration, Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Aircraft refrigeration cycles, Numerical. **Non-conventional refrigeration system:** Thermoelectric refrigeration, pulse tube refrigeration, thermo acoustic refrigeration, vortex refrigeration, cooling by adiabatic demagnetization.

10 Hours

UNIT –3

Psychrometry: Introduction, Psychrometric properties and relations, Psychometric chart and its applications, First law applied to psychrometric process, numerical.

Psychometric processes: Basic processes in air conditioning, Adiabatic mixing of air streams, Psychrometric process in air conditioning equipment: Bypass factor, Adiabatic dew point, air washer, steam injection, heating coil, hygroscopic solution in air washer, adiabatic dehumidifier, numericals. **10 Hours**

UNIT –4

Refrigeration and Air conditioning equipments: Refrigeration Equipments: Compressors, condensers and cooling towers, evaporators, expansion devices, electric motors. Air conditioning Equipment's: air cleaning and air filters, humidifiers, de-humidifiers heating and cleaning equipment's, Factors effect on refrigeration capacity, Air-Refrigeration systems, Ideal cycle comparison with existing refrigeration systems. **10 Hours**

UNIT –5

Design Load Conditions: Choice of inside and outside design conditions, comfort chart, choice of supply design condition, need for ventilation, Load Calculations: Internal heat gains, system heat gains, break up of ventilation load, cooling and heating load estimate, grand sensible heat factor, effective sensible heat factor, design of air conditioning apparatus for cooling and dehumidification, Evaporative cooling, numerical.

Transmission and Distribution of Air: Room air distribution, Types of supply air outlets, mechanism of flow through outlet, considerations for selection and location of outlets, Distribution patterns of outlets. **10 Hours**

TEXT BOOKS

1. Refrigeration and Air conditioning by Arora C.P, Tata Mc Graw Hill Pub.
2. Refrigeration and Air Conditioning, Wilbert F. Stoecker, McGraw-Hill Pub.
3. Norman C. Harris, N. C., Modern Air Conditioning Practice, Third edition, McGraw- Hill Pub.
4. Refrigeration and Air-Conditioning., R. K. Rajput, S. K. Kataria & Sons Pub.

REFERENCES BOOKS

1. Levenhagen, J. L., Spethmann, D. H., Heating Ventilating and Air conditioning Controls and Systems, McGraw Hill Pub.
2. Refrigeration and Air conditioning by P. L. Ballaney, Hanna Pub.
3. Refrigeration and Air conditioning by Manohar Prasad, Wiley Eastern Pub.
4. Refrigeration and Air conditioning by Domkundwar, Dhanpat Rai Pub.
5. Refrigeration and Air conditioning by, Anantnarayan, Tata MC Graw Hill Pub.

E-BOOKS / WEB REFERENCES

1. http://nptel.ac.in/courses/112104113/
2. http://nptel.ac.in/courses/112108148/
3. http://nptel.ac.in/courses/112105123/

MOOCs:

1. https://www.coursera.org/course/introthermodynamics
2. https://www.iitbombayx.in/courses/IITBombayX/ME209xA15/2015_T1/about

COURSE OUTCOMES: Students will

CO1 Understand the basic concepts of refrigeration process.
CO2 Analyze the performance of various refrigeration cycles, Psychometric processes.
CO3 Examine various refrigeration and Air conditioning equipment's.
CO4 Analyze the heat load based on heat source.
CO5 Design the air duct for difference heat load and working conditions.

SCHEME OF EXAMINATION

<table>
<tr><td colspan="4">CIE – 50 Marks</td></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
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CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H										H
CO2	H	M	L									H
CO3	H	H										H
CO4	M	M	L									H
CO5	H	M										H

L – Low, M – Medium, H – High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP – 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEPE703E</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="4">Professional Elective-III</td><td colspan="2">Semester: VII</td></tr>
<tr><td>Course title</td><td colspan="6">FINANCIAL MANAGEMENT AND COSTING</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVE

1. To study the fundamentals of accountancy, cost accounting and management accounting
2. To know how various accounting methods can be applied for customers, shareholders and government.
3. Understanding concepts of practical application of financial management using audio and video presentations.
4. Understand the latest accounting methods by reference books and lectures will cover by students will be made to refer latest research publications.
5. To prepare the ever changing job market like industry, research, higher education and teaching.

UNIT - 1

Preview of Organization: Organizational Goals, types of decisions, benefits and costs relevant to operating and capacity decisions Financial Accounting: Book keeping: Double entry accounting, journal and ledger posting Financial statements and analysis: Trial balance, preparation of trading account and profit and loss account, balance sheet, funds flow statement and ratio analysis. **10 Hours**

UNIT - 2

Product costing: Production costs, nonproduction costs, Product costing with absorption & variable costing. Working Capital Management: Definition, need and factors influencing the working capital requirement. Determination of operating cycle, cash cycle and operating cycle analysis. Calculation of gross working capital and net working capital requirement.

10 Hours

UNIT-3

Variable and process costing system: element of cost, job costing, process costing Variable standard costing for efficiency: Types of standard costs, setting of standards, variable standard cost system, standard cost variance, selection of standard cost system. Financial statements i.e, Trading A/c, P & I A/c, Balance Sheet etc., numericals **10 Hours**

UNIT - 4

Cost and Production decisions: Contribution margin and Production decisions - adding a new product, sell or process further - make or buy decision, dropping the product line, Costing: Classification of cost, preparation of cost sheet, absorption and variable costing, job costing, process costing. Classification of the variances analysis – material, labour and overhead variances, numericals. **10 Hours**

UNIT - 5

Budgeting: Planning and control process, master budget - Profit plan, cash budget, capital expenditure budget, development of a master budget - sales forecast, cost behavior patterns. product cost, company objectives, sales budgets, production budget, raw materials, purchasing budget, factory cost budget, selling and administrative expense budget, profit plan, projected cash budget Responsibility Accounting and Budgetary Control: Responsibility accounting - cost centres profit or contributions centres. Responsibility planning, accounting and control process **10Hours**

TEXT BOOKS

1. Financial Management, Khan & Jain, text & problems TMH ISBN 0-07-460208-A. 2001.
2. Financial Accounting, Costing and Management Accounting, S. M. Maheshwari, 2000.

Books for Reference:

1 Management accounting - Wiley international, Don T December, Elton L Schafer, Marie T Ziegler.
2. Managerial Accounting - Garrison, BPI
3. Management accounting - Horn Gren PHI
4.Advanced Accounting - J.R. Batliboi, The standard accountancy publications Pvt. LTD
5. Financial Management, I. M. Pandey, Vikas Publication House ISBN 0-7069-5435-1, 2002.
6) Financial Management, Abrish Gupta, Pearson.

MOOCs:

1 https://youtu.be/TgF2XvjquUU
2 https://youtu.be/kIgBgbnOAvI

E-BOOKS:

1. https://books.google.co.in/books?isbn=8131711048, Taha – 2008.
2.https://books.google.co.in/books?isbn=8121902819 –
3. https://books.google.co.in/books?isbn=8131700003,A. M. Natara P. Balasubramani – 2006

Course outcome: Students will

CO1: The students this course will be an elective subject for B.Tech in Mechanical Engineering.

CO2: The students will study using a text book and reference books, class lectures, audio and video presentation by the faculty.

CO3: By the end of semester, he would gain insight into latest accounting techniques used

by large corporations.

CO4: The teaching and learning process will be tested by use of Quiz, Tests, Paper Presentation, and Final Examinations.

CO5: The students get prepared for the challenges he will face after the course completion.

SCHEME OF EXAMINATION.

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE – 20*5 = 100 Marks (To be scaled down to 50 Marks)			
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CO – GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	H							H			H
CO2	H	M	H									H
CO3	M	H						M				H
CO4	M	H	L									H
CO5	H	M						H				H

L – Low, M – Medium, H – High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEOE704A</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Open Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">FUNDAMENTALS OF ROBOTICS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Understand the basic terminologies and concepts associated with robots.
2. Evaluate the various types of drive systems and control technologies in Robotics and analyze basic gripper systems
3. Analyze the problems related to basic kinematics of an Industrial robot.
4. Understand the various teaching methods and robot programming languages and create program for industrial applications
5. Examine sensors in robotics, which is used to build various industrial applications.

COURSE CONTENTS

UNIT-1

INTRODUCTION: Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. **8 Hours**

UNIT- 2

DRIVES, CONTROL SYSTEM AND GRIPPERS: Types of Drives, Actuation and its selection while designing a Robot Systems, Types of Transmission System, Concepts about basic control system, Control loops of Robotic Systems, Different types of Controllers-Proportional, Integral, Differential PID controllers Types of Grippers, Design Aspects of Grippers, Force Analysis for Various Basic Gripper Systems. **8 Hours**

UNIT- 3

KINEMATICS OF ROBOT MANIPULATOR: Introduction, General Mathematical Preliminaries on Vectors& Matrices, Direct Kinematics problem, Geometry Based Direct kinematics problem, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Problems, Composite Rotation matrix, Homogenous Transformations,, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation. **12 Hours**

UNIT- 4

ROBOT TEACHING: Introduction, Various teaching methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL and their Features, Typical Programming Examples such as Palletizing, Loading a Machine etc. **12 Hours**

UNIT –5

ROBOT SENSING & VISION: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System: Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

INDUSTRIAL APPLICATIONS: Robot Application in Industry, Task Programming, Robot Intelligence, and Task Planning, Modern Robots, Future Application and Challenges and Case Studies. **10 Hours**

TEXT BOOKS

1. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.
2. Robotics for Engineers –Yoram Koren, McGraw Hill International, 1st edition, 1985.
3. Mikell P. Groover Et. Al., ―Industrial Robotics, Technology Programming and Applications McGraw-Hill International 1986.

REFERENCE BOOKS

1. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
2. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
3. Shimon Y. Nof, Handbook of Industrial Robotics. John Wiley Co, 01.
4. R.C. Drof, John Wiley and Sons ―Hand Book of Design, Manufacturing & Automation

EBOOKS / ONLINE RESOURCES

1. https://www.perlego.com/book/1645669/fundamentals-of-robotics
2. https://www.ebooknetworking.net/ebooks/fundamentals-of-robotics-by-d-k-pratihar
3. https://books.google.co.in/books/about/Fundamentals_of_Robotics_Engineering.html

MOOCs

1. https://www.coursera.org/specializations/modernrobotics
2. https://www.edx.org/learn/robotics
3. https://onlinecourses.nptel.ac.in/noc20_de11/preview

COURSE OUTCOMES: Students will

CO1: Explain the basic concepts of Industrial robot.
CO2: Select the suitable drive system and control systems, while designing a robot and solve the problems
CO3: Solve the problems of direct and inverse kinematics analysis of industrial robot.
CO4: Explain the basic principles of robot programming and develop the typical programs for Pick & place, loading & unloading and palletizing applications
CO5: Evaluate the appropriate Sensor and Machine vision system to develop a model for an application.

SCHEME OF EXAMINATION

CIE – 50 Marks			
Unit 1, 2 & 3		Unit 4 & 5	
Test I	AAT I	Test II	AAT II
20 Marks	05 Marks	20 Marks	05 Marks
SEE - 20*5 = 100 Marks (To be Scaled down to 50 Marks)			

There shall be 10 questions

- Two full questions to be set from each unit with internal choice.
  - ✓ Minimum number of sub questions : 2
  - ✓ Maximum number of sub questions : 3
- Each full question shall be for a maximum of 20 marks.
- Answer any *Five* full questions choosing at least One full question from each unit.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	M							M		M	
CO2	H	H	M		M							
CO3	H	M		M					H		H	
CO4	H	M			M							
CO5	H	M		M								

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEOE704B</td><td colspan="3">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Category</td><td colspan="5">Open Elective-II</td><td>Semester:VII</td></tr>
<tr><td>Course title</td><td colspan="6">SMART MATERIALS</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 50</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>S</td><td>Credits</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES

1. Identify the smart and composite materials, its classification.
2. Understand the strength and weaknesses of a given class of smart materials.
3. Apply of smart material to build smart systems.
4. Analyze Strengths and weaknesses of smart material in the design of a product.
5. Integration of smart materials as sensor and actuator to build smart systems.

UNIT – 1

Introduction: Characteristics of metals, polymers and ceramics. Introduction to smart materials, need of Smart Materials and Structures, Classification of smart materials. Sensing and actuation: Principles of electromagnetic, acoustics, chemical and mechanical sensing and actuation. Types of sensors and their applications, closed loop and open loop Smart Structures, Smart Devices

Composites: Fiber, matrix, properties and fabrication processes, types/classification of composites, fabrication methods of composites, rule of mixtures, Smart composite materials, self-sensing and self-healing materials, applications and problems. **10 Hours**

UNIT – 2

Piezoelectric materials, Properties, fabrication and types, piezoelectric Constitutive Relations, depoling and coercive Field, field strain relation. Hysteresis, Creep and Strain rate effects, Inchworm Linear Motor, actuators for precision movement control. , Beam modeling with induced strain Rate effects single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Applications and problems. **10 Hours**

UNIT – 3

Introduction and classification of shape memory alloys and polymers, Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Influence of stress on characteristic temperatures, Modelling of shape memory effect, Vibration Control through SMA, Multiplexing. Applications and Problems **10 Hours**

UNIT – 4

Electro rheological (ER) and magneto rheological (MR) fluids: Mechanisms and properties, fluid composition and behaviour, The Bingham plastic and related models, Pre-yield response. Post-yield flow, applications in clutches and vibration dampers.

Dielectric elastomer, Electroactive materials, Thermoelectric materials, Photomechanical materials, Chromogenic material, Thermochromic, Photochromic, Piezochromic, Magnetochromic, Magnetostrictive and Functionally Graded Materials. **10 Hours**

UNIT – 5

Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in crack detection, Elements of signal processing, Wearable smart materials, Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of Theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration, MEMS devices. **10Hours**

TEXT BOOKS

1 A. V. Srinivasan and D Micheal Mcfarland, Smart Stzructures: Analysis and Design, Cambridge University Press, Cambridge, 2001

2 B. Culshaw, Smart Structures and Materials, Artech House, Boston, 1996 (ISBN: 0890066817).

REFERENCE BOOKS

1. Mazumdar S. K., "Composite Manufacturing – Materials, Product and Processing Engineering", CRC Press, Boca Raton
2. M. V. Gandhi and B. S. Thompson, Smart Materials and Structures, Chapman and Hall, London, New York, 1992 (ISBN: 0412370107).
3. Banks H T, RC Smith, Y Wang, Massow S A , Smart Materials and Structures, Wiley – Blackwell, ISBN-13: 978-0471970248

EBOOKS / ONLINE RESOURCES

1 . https://www.researchgate.net/publication/281836834_Smart_Materials_and_Structures

2 https://www.ltrc.lsu.edu/pdf/report_375.pdf

3 https://www.sciencedirect.com/science/article/abs/pii/026130699290045J

4 https://www.worldscientific.com/doi/10.1142/9789812797360_0009

MOOCs

1 https://onlinecourses.nptel.ac.in/noc22_me17/preview

2https://www.classcentral.com/course/swayam-smart-materials-and-intelligent-system-design-14288

3 https://www.iitk.ac.in/smss/post/swayam_noc21_me60/

4 https://courseware.cutm.ac.in/courses/10366/

COURSE OUTCOMES: Students will

CO1: Understanding smart materials, its classification.
CO2: Describe and selection of smart materials.
CO3: Conduct experiments to verify the predictions of smart structures.
CO4: Validation on compatibility of smart structure & smart materials.
CO5: Design simple models and devices for smart structures

SCHEME OF EXAMINATION

<table>
<tr><th colspan="4">CIE – 50 Marks</th></tr>
<tr><td colspan="2">Unit 1, 2 & 3</td><td colspan="2">Unit 4 & 5</td></tr>
<tr><td>Test I</td><td>AAT I</td><td>Test II</td><td>AAT II</td></tr>
<tr><td>20 Marks</td><td>05 Marks</td><td>20 Marks</td><td>05 Marks</td></tr>
<tr><td colspan="4">SEE - 20*5 = 100 Marks
(To be Scaled down to 50 Marks)</td></tr>
<tr><td colspan="4">There shall be 10 questions
• Two full questions to be set from each unit with internal choice.
✓ Minimum number of sub questions : 2
✓ Maximum number of sub questions : 3
• Each full question shall be for a maximum of 20 marks.
• Answer any Five full questions choosing at least One full question from each unit.</td></tr>
</table>

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	M	M		M							M	
CO2					M	M				L	M	
CO3	H				M							
CO4	M		M	M						L	M	
CO5			M	H								

L – Low, M – Medium, H -High

<table>
<tr><td>Course Code</td><td colspan="2">21MEPW705L</td><td colspan="3">B. Tech. (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="4">Internship</td><td>Semester: VII</td></tr>
<tr><td>Course title</td><td colspan="5">PROJECT WORK</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="4">No. of Hours/Week</td><td></td><td rowspan="3">Total hours/Week = 09</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>9</td><td>28</td><td>10</td></tr>
<tr><td>CIE Marks: 50</td><td colspan="2">SEE Marks: 50</td><td colspan="2">Total Max. Marks: 100</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="6">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students:

1. To select a problem applying relevant knowledge and skills acquired during the program.
2. To carry out literature survey to identify and present the problem formulation.
3. To finalize the specification of the project work, prepare project plan and methodology, considering professional, cultural and societal factors.
4. To develop experimental planning and select appropriate techniques and tools to conduct experiments to evaluate and critically examine the outcomes.
5. To prepare synopsis and preliminary report for approval of topic selected.
6. To develop oral and written communication skills to effectively convey the technical content.

COURSE CONTENT

GUIDELINES:

1. Project work is a continuation of preliminary project work started in 7th semester.
2. Project team has to execute the work and test the prototype / algorithm within the timeline.
3. Project team has to demonstrate the successful working of prototype / algorithm developed.
4. Project team has to document the work carried out in the form of a report in prescribed format and submit to the department.
5. Project team has to make a technical presentation of the work carried out to the Project Evaluation Committee of the Department.

COURSE OUTCOMES: Students will

CO1: Literature review on par with international journal standards.
CO2: Literature gap determination and definition of the problem.
CO3: Scientific Design / Numerical Analysis / Analytical model and interpret them.
CO4: Apply tools / techniques for problem solving and prepare project work.
CO5: Apply the above mentioned techniques for problem solving and prepare project work with results and discussion.

SCHEME OF EXAMINATION

Each faculty member is to be assigned 2 to3 batches of students each batch may have 4 or 5 students. The assessment is to be conducted for 50 marks for CIE and 100 Marks for SEE and reduced to 50 marks to be incorporated in the result. Internship Seminars has to be presented

once in 15 days with the concern of the respective Guide/s, Coordinator and Chairperson about the progress of the Project Work.

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For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Topic of internship	10%	50
2.	Objectives of internship	10%	
3.	Specific skills acquired	20%	
4.	Documentation	40%	
5.	Presentation	20%	
Total		100%	

Each student is required to maintain an individual logbook, where he/she is supposed to record day to day activities. The project log is assessed on an individual basis, thus allowing for individual members within groups to be assessed this way. The assessment will take into consideration the individual student's involvement in the assigned work.

Rubrics for SEE:

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Topic of internship	10%	100 To be reduced to 50
2.	Objectives of internship	10%	
3.	Specific skills acquired (Write up about in Internship)	20%	
4.	Presentation	40%	
5.	Viva-Voce	20%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H									
CO2	H	H	M									
CO3	H	H	M									
CO4	H	H	M									
CO5	H	H	H									

L - Low, M - Medium, H –High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus – CBCS & NEP - 2021

<table>
<tr><td>Course Title</td><td colspan="5">AUTOMATION LABORATORY</td><td colspan="2">B. Tech (Mechanical Engineering)</td></tr>
<tr><td>Course Code</td><td colspan="7">21MEAE706</td></tr>
<tr><td>Category</td><td colspan="7">ABILITY ENHANCEMENT COURSE</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">Total No. of Hours / Week = 32</td><td colspan="2" rowspan="3">VII Semester</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks:50</td><td colspan="2">SEE Marks: 50</td><td colspan="3">Total Max. Marks: 100</td><td colspan="2">Duration of SEE: 3 Hrs</td></tr>
</table>

COURSE OBJECTIVES

1. Apply symbols, basic terminologies and components of Hydraulic system, Pneumatics, Electro-Pneumatics system and PLC.
2. Understand and the concepts of Hydraulics, and Pneumatics to build basic circuits
3. Analyze and evaluate concepts of Electro-pneumatic and Electro-Hydraulics to build control circuits.
4. Analyze and evaluate the concepts of PLC for controlling Electro-pneumatic and Electro-Hydraulic to build automated control circuits.
5. Create an Automated system using concepts of Programmable Logic Controllers interfaced with Electro-Hydraulics/Pneumatics for industrial applications.

UNIT – 1

Computer Simulation and experiments of pneumatic and hydraulics circuits:

Regenerative circuit, Speed Control circuits: meter-in and meter-out, Sequencing circuit, Rapid Traverse and Feed circuit, Automatic to & fro motion of a double acting actuators using 5/3 DCV and Logical circuits using shuttle valve and two pressure valve. Industrial applications circuits built with use of time delay valve, pressure sequence valve and counter.

16 Hours

UNIT – 2

Computer Simulation and experiments of electro-pneumatics and electro-hydraulic circuits involving PLC:

Use of solenoid operated DCV and relay to built Speed Control circuits: meter-in and meter-out, Sequencing circuit, Reciprocating motion of a double acting actuators and Logical circuits using shuttle valve and two pressure valve. Industrial applications circuits built with use of timer, pressure sequence valve and counter.

16 Hours

REFERENCE BOOKS

1. Hasebrink J.P., and Kobler R., ―Fundamentals of Pneumatics/Electropeumatics‖, FESTO Didactic publication No. 7301, Esslingen Germany, 1979.
2. Ackermann et al., Programmable logic controllers –Advanced level, Festo Didactic KG, 1991
3. J.R. Hackworth and F.D. Hackworth, Jr., Programmable logic controllers-Programming methods and applications, Pearson Education, Prentice hall.

MOOCs

1 https://www.classcentral.com/course/swayam-industrial-automation-and-control-5222

2 https://onlinecourses.nptel.ac.in/noc20_me39/preview

COURSE OUTCOMES: Students will

1. Implement the features of Hydraulics, Pneumatics, Electro-Pneumatics system and PLC.
2. Experiment or Simulate and Validate the Control circuit of Hydraulics, Pneumatics and Control.
3. Develop and simulate the control circuits built using Electro- Pneumatics and Electro Hydraulics control.
4. Assess the use of PLC by experiment or simulation of automated pneumatics and hydraulics control circuits.
5. Investigate an Automated system developed by interfacing Programmable Logic Controllers with Electro-Pneumatics /Hydraulics.

SCHEME OF EXAMINATION

Continuous Internal Evaluation (CIE) (Laboratory– 50 marks)	**Mark**	**Semester End Evaluation (SEE) (Laboratory – 100 marks)**	**Marks**
Performance of the student in the laboratory every week	25	Write up (UNIT-1) = 20 marks Write up (UNIT-2) = 20 marks	40
Test at the end of the semester Experiment-1 (UNIT-1) = 10 marks Experiment-2 (UNIT-2) = 10 marks	20	Experiment-1 (UNIT-1) = 20 marks Experiment-2 (UNIT-2) = 20 marks	40
Viva Voce	05	Viva Voce	20
Total (CIE)	**50**	**Total**	**100 ***

Note: * SEE shall be conducted for 100 marks and the marks obtained shall be reduced for 50 marks.

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H				M							
CO2	H		H									
CO3	H				M							
CO4	H		M		M							
CO5	H			H								

L – Low, M – Medium, H -High

BANGALORE UNIVERSITY

Department of Mechanical Engineering, UVCE, Bengaluru.

Scheme and Syllabus — CBCS & NEP - 2021

<table>
<tr><td>Course Code</td><td colspan="3">21MEIN801</td><td colspan="3">B. Tech (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="4">Internship</td><td colspan="2">Semester:VII /VIII</td></tr>
<tr><td>Course title</td><td colspan="6">RESEARCH/INDUSTRIAL INTERNSHIP</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours / Week = 15</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>0</td><td>15</td><td>40</td><td>15</td></tr>
<tr><td>CIE Marks: 100</td><td colspan="2">SEE Marks: 100</td><td colspan="3">Total Max. Marks: 200</td><td>Duration of SEE: 3 Hrs</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

The course will enable the students:

1. To equip students for making a technical presentation based on a thorough research review on any contemporary area of Engineering and Management fields
2. Offering the student an opportunity to interact with faculty and peer group and to build the ability to making independent presentation.
3. Develop methodologies to resolve the identified problem.
4. Develop presentation slides / report arranging the material coherently and discuss the Vtopic with clarity and confidence.
5. Summarize the presentation, submit the report and identify scope for further work.

COURSE CONTENT

Research Internships

Research internships are focused on research projects that push student's intellectual abilities beyond those driven by the classroom. Often, research internship typically helps to solve problems which are usually part of major research projects. It involves a short theoretical or experimental research project supervised by a researcher.

The research internships, under the advice of a faculty supervisor, can be a one's own selected project or a project on which a Researcher is researching or a new project/real-world project offered by an organization. The research area may be pertaining to single or multidisciplinary fields such as science, technology, engineering, mathematics, management, and business studies. Research internships can be carried out either individually or in teams (not exceeding 3 or 4 students).

Research internship opportunities, before graduation, may be in a laboratory of college, a research institute, or a company's R&D department. Apart from fixed working hours of the day of an organization, the researcher can devote sufficient time

for other research related activities for an early and successful completion of the Research Internship.

Research Internship / industry Internship of sufficient duration encourages students early on in their career. Its main goal is to give an opportunity to improve their analytical and technical skills in an international environment. Internship can be in an industry or at an appropriate work place.

Research internships and industrial internships have different purposes and come with their set of benefits. A prior experience in any field is always preferred over a fresh start. Therefore, one of them can be selected depending on the interest the students have. Internships pose unexpected challenges and make students to think appropriately, tackle difficulties with ease and act in a scholarly way to get past the hurdles and practical constraints. An internship is always beneficial however good or bad it is.

Internships not only enhance one's learning but also identify him/her as someone who has the commitment to approaching a project and completing it with or without the guidance. The internship learning is an impetus to professional development.

While research internship is a step stone to higher studies, an industry internship is a pathway for a placement. Those who are self-motivated and interested in search of new things that are original and unique can choose a research internship. Those who are interested in the real industry experience and aspire to get a job soon after graduation and choose an industry internship.

Research internship Outcomes

- Generating technical paper/s and publish in referred journal/s.
- Possibility of acquiring an intellectual ownership and patent.
- Build a prototype for an idea on which the research was carried out.
- Add academic Knowledge to the field.
- Enhanced ability in arranging meetings, presentations, seminars, trainings, etc.
- Improved conscientiousness and ethics

Necessary skills for research Internship and Industry Internship

For the Internship to progress without hurdle and for successful completion, the Researcher should maintain a harmonious relationship with the guides, administrators, co-workers and others, and strictly adhere to the rules and regulations of the workplace. The other skills required or acquirable during the internship are,

1. Good Communication skills.
2. Attention to detail.
3. Planning and scheduling.
4. Documentation.

5. Critical thinking.
6. Data collection.
7. Data analysis.
8. Ability to maintain quality, safety and/ Standards.
9. Appreciating and practicing the ethical issues.

COURSE OUTCOMES: Students will

CO1: Literature review on par with international journal standards.
CO2: Literature gap determination and definition of the problem.
CO3: Scientific Design / Numerical Analysis / Analytical model and interpret them.
CO4: Apply tools / techniques for problem solving and prepare project work.
CO5: Apply the above mentioned techniques for problem solving and prepare project work with results and discussion.

SCHEME OF EXAMINATION

Each faculty member is to be assigned 2 to3 batches of students each batch may have 4 or 5 students. The assessment is to be conducted for 50 marks for CIE and 100 Marks for SEE and reduced to 50 marks to be incorporated in the result. Internship Seminars has to be presented once in 15 days with the concern of the respective Guide/s, Coordinator and Chairperson about the progress of the Research /Industry Internship.

For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Presentation of background of Research work and maintenance of Research Diary	10%	100
2.	Literature survey, Problem formulation and Objectives	10%	
3.	Presentation of methodology and experimentation	20%	
4.	Results and Discussion	40%	
5.	Presentation (Questions and Answers)	20%	
Total		100%	

Each student is required to maintain an individual logbook, where he/she is supposed to record day to day activities. The Research/Industrial Internship is assessed on an individual basis, thus allowing for individual members within groups to be assessed this way. The assessment will take into consideration the individual student's involvement in the assigned work.

Rubrics for SEE:

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Originality	10%	100
2.	Literature survey	15 %	
3.	Problem formulation, Objectives and Scope of World	20%	
4.	Methodology, Experimentation/Theoretical modelling	15%	
5.	Results, Discussion and Conclusion	20%	
6.	Viva-Voce	10%	
7.	Submission/ Publication of technical paper in Journals / Conference	10%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H									L
CO2	H	H	M									M
CO3	H	H	M									M
CO4	H	H	M									L
CO5	H	H	H									L

L - Low, M - Medium, H –High

<table>
<tr><td>Course Code</td><td colspan="2">21MESE802</td><td colspan="4">B. Tech. (Common to All Branches)</td></tr>
<tr><td>Category</td><td colspan="5">Technical Seminar /Industrial Visit</td><td>Semester: VIII</td></tr>
<tr><td>Course title</td><td colspan="6">Technical Seminar /Industrial Visit</td></tr>
<tr><td rowspan="3">Scheme and Credits</td><td colspan="5">No. of Hours/Week</td><td rowspan="3">Total hours = 2hrs /Week</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>SS</td><td>Credits</td></tr>
<tr><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>CIE Marks: 100</td><td colspan="2">SEE Marks: NIL</td><td colspan="3">Total Max. Marks: 100</td><td>Duration of SEE: NIL</td></tr>
<tr><td colspan="7">Prerequisites (if any): NIL</td></tr>
</table>

COURSE OBJECTIVES:

- The course will enable the students to Technical Seminar is :
  1. To encourage the students to study advanced engineering developments
  2. To prepare and present technical reports.
  3. To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

- The course will enable the students to Industrial Visit is:

  1. It provides students with an opportunity to learn practically through interaction, working methods and employment practices.
  2. It gives them exposure to current work practices as opposed to possibly theoretical knowledge being taught at college. I
  3. Industrial visits provide an excellent opportunity to interact with industries and know more about industrial environment.
  4. Industrial visits are arranged by colleges to students with an objective of providing students functional opportunity in different sectors like IT, Manufacturing and services, finance and marketing.
  5. Industrial visit helps to combine theoretical knowledge with industrial knowledge. Industrial realities are opened to the students through industrial visits.

COURSE CONTENT

TECHNICAL SEMINAR

Seminar Deliverable at the Institution under the supervision of a Faculty are mentioned.

- Seminar is one of the head of passing.

i) Each candidate shall deliver seminar as per the Scheme of Teaching and Examination on the topics chosen from the relevant fields for about 10 to 15 minutes.

ii) The Head of the Department shall make arrangements for conducting seminars through concerned faculty members of the Department. The

committee constituted for the purpose by the Head of the Department shall award the CIE marks for the seminar.

iii) The committee shall consist of three faculty from the Department and the senior most acting as the Chairman/Chairperson.

- For Technical seminar, the CIE marks shall be 100. The CIE marks in the case of projects and seminars in the final year shall be based on the evaluation at the end of VIII semester by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the project / seminar guide.
- If any student fails to secure a minimum of 40% of the maximum CIE marks in seminar/ fails to deliver the seminar, he/she shall be considered as failed in that Course and shall not be eligible for the award of degree. However, the student shall become eligible for the award of degree after satisfying the requirements prescribed for seminar during the subsequent semester/s.
- Improvement of CIE marks shall not be allowed in Seminar where the student has already secured the minimum required marks.
- Seminar topics must be from recent advancements in the domain. Each candidate must submit three copies of the report to the department. One for the candidate, one for the guide and one for the department.

INDUSTRIAL VISIT

Industrial visits are an essential part of the academic curriculum in most of the Graduate and Post-graduate courses. Being a part of interactive learning, such educational visits give students a major exposure to real working environments along with a practical perspective of a theoretical concept relevant to their domain. In addition to that, industrial visits bridge the widening gap between theoretical learning and practical exposure by giving students the first-hand exposure to identify the inputs and outputs for different business operations and processes performed at the workplace.

Intending to go beyond classroom learning, the industrial tours contribute a lot in holistic student development by letting students learn about the current trends in the market, the future scenario of the industry and the new technologies that are being applied in the industry.

Given below are a few significant benefits of industrial tours:

- **Opportunity to interact with Industry Experts:** Industrial visits provide students with a chance to meet industry leaders, professionals, entrepreneurs, policymakers, and corporates who share their wisdom, learning, and experiences. These interactions are useful to students in their career and help them in developing leadership qualities, management skills, and learn about the industry working.

- **Learning experience:** Educational tours to industries provide an opportunity for students to see and experience real workstations, plants, machines, systems, assembly lines, and interact with highly trained and experienced personnel. This practical learning experience is necessary for students who have to date studied theory only and are unaware of a real production plant’s daily workings. The students learn about company policies in terms of

production, quality, and service management and acquaint themselves with the working of instruments during the course curriculum.

- **Enhanced employability:** Industrial visits play a crucial role in increasing networking opportunities while building a good relationship with companies. For students, such trips open many doors for corporate training and internships, which in turn increase the students' employability.

- **Management Lessons:** During the industrial visits, the students get an opportunity to experience how professionals live, learn about various management concepts like Just in Time or Lean manufacturing and how they are put into action. It is not easy to manage hundreds of skilled and unskilled workers at the same time and meet the stringent quality norms and production targets of the company.

- **Interpersonal skills enhancement:** Industrial trips help students to enhance their interpersonal, communication skills, and teamwork abilities. These visits have, time and again, proved to be an excellent platform for networking as the students interact and connect with the corporate.

Industrial visits are usually the first point of interaction between a student and a live working industry. The students learn about the latest technology trend and make up their minds about their future job or area of interest. This trip should not be wasted in idle fun and jokes and should be used for team bonding and learning along with a bit of fun.

COURSE OUTCOMES: The students should be able to:

CO1: Survey the changes in the technologies relevant to the topic selected
CO2: Discuss the technology and interpret the impact on the society, environment and domain.
CO3: Compile report of the study and present to the audience, following the ethics.
CO4: Industrial visit has its own importance in a career of a student who is pursuing a professional degree.
CO5: It is considered as a part of college curriculum, mainly seen in engineering courses.
CO6: Objectives of industrial visit is to provide students an insight regarding internal working of companies.
CO7: Industrial visit provides student a practical perspective on the world of work

SCHEME OF EXAMINATION

Technical Seminar

During the seminar session each student is expected to prepare and present atopic on engineering/ technology, for duration of about 10 to 15 minutes In a session. Each student is expected to present at least twice during the semester and the student is evaluated based on presentation and advance technological skill/developments that globally in progress. At the end of the semester, he / shecan submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

For CIE the weightings shall be

Sl. No.	Particulars	Weightage	Total marks of CIE
1.	Topic of Technical Seminar	10%	100
2.	Objectives of Technical Seminar	10%	
3.	Specific skills acquired	20%	
4.	Documentation	40%	
5.	Presentation	20%	
Total		100%	

INDUSTRIAL VISIT

Each student is required to attend the Industrial visit, the detailed report submission and also the detailed technical and outcomes of the Industry is to be reported in the form ofa report. The assessment will made in consideration the individual student's involvement in the assigned work.

For CIE the Weightage shall be

Sl. No.	Particulars	Weightage	Total marks of SEE
1.	Attendance for the industrial visit	10%	100
2.	Involvement in the Industry visit	10%	
3.	Report preparation of the Industry visit with technical in detail.	40%	
4.	Presentation	20%	
5.	Viva-Voce	20%	
Total		100%	

CO-GA MAPPING

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	H	H	H				M			M		M
CO2	H	H	M		M				M		M	M
CO3	H	H	M		M					M		L
CO4	H	H	M				M				M	L
CO5	H	H	H		M				M		M	L

L - Low, M - Medium, H –High