SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with "A" Grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.
Phone: 044 - 2450 3150 / 51 / 52 / 54 / 55 Fax: 044 - 2450 2344
www.sathyabama.ac.in

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SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MECHANICAL ENGINEERING

Department of Mechanical Engineering

Minutes of Board of Studies Virtual meeting held on 27th June 2020.

The following members were present in the meeting:

1. Dr.L.Vijayaraghavan, Professor- IIT Madras - External Member
2. Er.James Michael Amulu, Director- SAP - External Member
3. Dr.G.Arunkumar, Professor and Head- Mechanical Engineering - Internal Member
4. Dr.S.P.Venkatesan, Associate Professor- Mechanical Engineering - Internal Member
5. Dr.G.Senthilkumar, Associate Professor- Mechanical Engineering - Internal Member
6. Dr. J.Jayaprabhakar, Associate Professor- Mechanical Engineering- Internal Member
7. Dr.S.Ganesan, Associate Professor – Mechancial Engineering – Internal Member
8. Ms. Sanjana Kallat, Alumni- Internal Member.

At the outset, the Chair Person welcomed the members of BoS and placed the agenda for the deliberations of the members. The following deliberations were made as per the items of the circulated agenda.

1.Agenda item # 1 Modifications proposed for 2020 batch Bachelors of Engineering– Mechanical Engineering students in SMEA1402 – Mechanics of Machines.

Head of the department informed that the department teams have been working on the modification of curriculum and in this direction the following changes were made on SMEA1402– Mechanics of Machines.

(a) Removal of the following topics in Unit V- Gears, Path of contact, arc of contact and contact ratio– Gear trains Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio.

(b) Inclusion of the following topics in Unit V: Effects of Gyroscopic Effects, Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle (Demonstration of models in video)

Resolutions: The External members considered the revision made and discussed regarding the revision. Dr. G.Arunkumar pointed that the removal of topics was necessary. These topics are covered in Design of Transmission system. Then the members approved the

modification in curriculum for consideration. The matter regarding the implementation of scheme from academic year 2020-21 batch onwards.

2. Agenda item # 2 Addition of new Course for 'Bachelors of Engineering– Mechanical Engineering'

The Head of the department highlighted the feedback from the Alumni for the incorporation of elective courses focus on emerging technologies and the feedback from Dr.L.Vijayaraghavan and Er.James Michael Amulu are to focus on Industry 4.0 Design and Manufacturing & Quality Control and Reliability Engineering. Based on the feedback, Department proposed the following courses for the incorporation of the following courses from July 2020 onwards.

Course 1: Industry 4.0 Design and Manufacturing
Course 2: Quality Control and Reliability Engineering

Resolutions: The BOS resolved to recommend for approval of the suggested courses for inclusion in B.E Programme of Mechanical Engineering. Dr.L.Vijayaraghavan and Mr.James Michael Amulu highlighted the importance of Industry 4.0 Design and Manufacturing & Quality Control and Reliability Engineering also suggested to incorporate in core Courses.

3. Skilling in professional domains to promote industry ready competency among learners. Necessary certification courses to improve the domain knowledge.

Head pointed the workshop offered by the department such as **Patent filing and Non Destructive Testing.**

Resolutions: The BoS recommended the same to promote the industry ready Competency among the students.

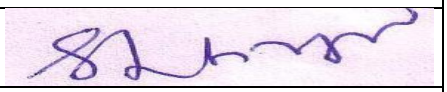
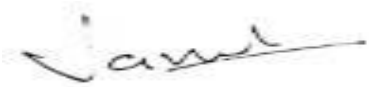
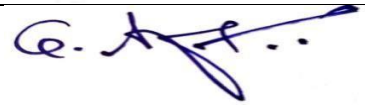
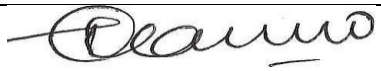
4. Any other points with the permission of Chair :

Academic flexibilities with extra credits acquired through either advanced study of same courses or with procuring additional credits from additional courses as per student's choice - suggestion. Universal Human values to be introduced as a mandate course

Head asked the suggestion to the External members for students undergoing specialization.

Resolutions: The BoS recommended that advanced courses/NPTEL courses and can be selected for the specialization. Also recommend that the students can opt these courses at the end of the fourth semester subject to the condition prescribed by the Board of Management time to time.

With the above discussion, the Head expressed his deep sense of gratitude to all members for an academic vibrant discussion on various matters. Since there was no other agenda, the meeting ended with the Vote of thanks to the Chair.

Member	Designation	Signature
Dr.L.Vijayaraghavan	Professor	
Er.James Michael Amulu	Director	
Dr.G.Arunkumar	Professor and Head	
Dr.S.P.Venkatesan,	Associate Professor	
Dr.G.Senthilkumar	Associate Professor	
Dr. J.Jayaprabakar	Associate Professor	
Dr.S.Ganesan	Associate Professor	

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1. Agenda item # 1 Modifications proposed for SMEA1402 – Mechanics of Machines Course.

S.No	Existing Syllabus R2019	Corrected Syllabus
1	UNIT V GEARS, GOVERNORS AND GYROSCOPES 9 Hrs Spur gear terminology – law of toothed gearing – Involutes gearing – Path of contact arc of contact and contact ratio Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method o finding velocity ratio. Governors – Types Centrifugal governors – Porter- Characteristics –Sensitivity – Stability – Hunting – Isochronisms – equilibrium speed Controlling -Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes	UNIT V GOVERNORS AND GYROSCOPES 9 Hrs Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships gyroscopic couple, (Demonstration of models in video). Governors - types and applications - Watt, porter and proell governors - spring loaded governors -Hartnell and Hartung with auxiliary springs. Sensitiveness- isochronisms and hunting.

SMEA1402	MECHANICS OF MACHINES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Provide the insights of the fundamentals of Mechanisms and Cams.
- Understand the basics of Flywheels, Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge of Single degree - Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- Discuss the fundamentals of Gears, Gyroscopes and Governors.

UNIT 1 MECHANISMS AND CAMS 9 Hrs.

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT 2 FLY WHEELS AND BALANCING 9 Hrs.

Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT 3 FUNDAMENTALS OF VIBRATION 9 Hrs.

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping –Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT 4 FORCED VIBRATION 9 Hrs.

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples.

UNIT 5 GEARS, GOVERNORS AND GYROSCOPES 9 Hrs

Spur gear terminology – law of toothed gearing – Involutes gearing – Path of contact, arc of contact and contact ratio. Interchangeable gears – Gear tooth action – interference and undercutting – Gear trains – Epicyclic gear train – tabular method of finding velocity ratio.Governors - Types - Centrifugal governors – Porter– Characteristics –Sensitivity – Stability – Hunting – Isochronisms – equilibrium speed - Controlling Force- Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in Aeroplanes.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Recommend the cam and follower arrangement for the specific case study.
CO2 - Examine the balancing of rotating and reciprocating unbalanced mass systems using analytical and graphical methods.
CO3 - Design the flywheels for the specific mechanical system using analytical techniques.
CO4 - Establish the free and/or forced vibration characteristics of the given mechanical system using analytical methods.
CO5 - Predict the gyroscopic effects on the stability of the given moving vehicle analytically.
CO6 - Compare the characteristics of governors for the specific automotive system.

TEXT/REFERENCE BOOKS

1. Khurmi R.S. & Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd., 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", 1st Edition, PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Edition, Tata Mcgraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms" SI Edition, 4th Edition, Oxford University Press, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A:	2 Questions each from CO1-CO4,1 question each from CO5 and CO6 – No choice	**20 Marks**
PART B:	4 Questions each with internal choice from CO1-CO4,1 question from CO5 and CO6 with internal choice , each carrying 16 marks	**80 Marks**

SMEA1402	MECHANICS OF MACHINES	School of Mechanical Engineering				
		L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

The aim of the course is to:

- Provide the insights of the fundamentals of Mechanisms and Cams.
- Understand the basics of Flywheels, Balancing of Rotating and Reciprocating unbalance systems.
- Enhance knowledge of Single degree - Free and Damped Vibrations.
- Provide the detailed overview of Forced Vibrations.
- Discuss the fundamentals of Gyroscopes and Governors.

UNIT I MECHANISMS AND CAMS **9 hrs**

Mechanisms – Terminology and definitions – Kinematics inversions of 4 bars and slider crank chain – Kinematic analysis in simple mechanisms. Types of cams and followers - Terminology and definitions – Displacement diagrams – SHM, uniform velocity, uniform acceleration and retardation. Graphical constructions of cam profiles – Disc cam with knife edge follower, roller follower and flat-faced follower.

UNIT II FLY WHEELS AND BALANCING **9 Hrs**

Turning moment diagrams – Fluctuation of Energy and speed – Energy stored in Flywheel – Mass of Flywheel – Dimensions of Flywheel. Balancing – Static and Dynamic Balancing of Rotating Masses - Balancing of several masses rotating in same plane and in different planes- Partial Balancing of locomotives – Variation of tractive force, Hammer blow and swaying couple.

UNIT III FUNDAMENTALS OF VIBRATION **9 Hrs**

Basic features of vibratory systems - Lumped mass systems - Degrees of freedom - Free vibration of Longitudinal, Transverse and Torsional systems of Single degree of freedom - Equations of motion - Natural frequency – Whirling of shafts and critical speed - Dunkerley's Method – Torsional vibration of Two and Three rotor system. Damped free vibration - Types of Damping – Critical damping coefficient - Damping Factor – Logarithmic Decrement.

UNIT IV FORCED VIBRATION **9 Hrs**

Forced vibration of single degree freedom system with damping - Response to periodic forcing- Harmonic Forcing - Force transmissibility and amplitude transmissibility - Reciprocating and rotating unbalance - vibration isolation and transmissibility - Support motion - self excited vibration with examples

UNIT V GOVERNORS AND GYROSCOPES **9 Hrs**

Gyroscopes and gyroscopic effects-Effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships gyroscopic couple, (Demonstration of models in video). Governors - types and applications - Watt, Porter and Proell governors - Spring loaded governors -Hartnell and Hartung with auxiliary springs. Sensitiveness- isochronisms and hunting.

Max Hours: 45 Hrs

COURSE OUTCOMES:

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

CO1: Investigate the Mechanisms and Cams.

CO2: Determine the principle of Flywheel, Rotating and Reciprocating masses.

CO3: Analyze the Single degree - Free and Damped Vibrations.

CO4: Evaluate the force transmitted to the foundation for mechanical systems in Forced Vibrations.

CO5: Apply the fundamentals of Gyroscopes.

CO6: Apply the fundamentals of Governors

TEXT/REFERENCE BOOKS:

1. Khurmi R.S& Gupta J.S, "Theory of Machines", 16th Edition, S.Chand & Company, 2005, Reprint 2016.
2. Singh V.P, "Mechanical Vibrations", 3rd Edition, Dhanpatrai & Co., 2006.
3. Ghosh A. and Malik A.M, "Theory of Mechanism and Machines", 4th Edition, Affiliated East West Press (P) Ltd. 2009.
4. Ashok G. Ambekar, "Mechanism and Machine Theory", First Edition,PHI Learning Private limited, 2009.
5. Rattan S. S, Theory of Machines, 3rd Ed., Tata Mcgraw Hill, 2009.
6. Gordon R Pennock, Joseph E Shigley, "Theory of Machine and Mechanisms SI Edition, 4th Edition, Oxford University Press, 2014

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks:100	Exam Duration: 3 hrs.
Part A: 10 questions of 2 marks each – No choice	20 marks
Part B: 2 questions from each unit of internal choice, each carrying 16 marks	80 marks

SMEA4003	INDUSTRY 4.0 FOR DESIGN AND MANUFACTURING	L	T	P	Credits	Total Marks
		2	-	0	2	100

COURSE OBJECTIVES

- To enable students understand the fundamentals and the contributing technologies of Industry 4.0.
- To make the students evaluate the suitability of Industry 4.0 technologies for the design andManufacturing sectors.
- To help the students implement the Industry 4.0 technologies to diverse applications.

UNIT 1 CONTRIBUTING TECHNOLOGIES 8 hrs

Brief introduction to the industrial revolutions. Contributing technologies to Industry 4.0: Additive manufacturing, Digital twin, Internet of things, Smart sensors, AR and VR, Artificial intelligence, Cloud computing, Block chain, Big data and analytics. Challenges and opportunities.

UNIT 2 ADVANCED CAD TECHNOLOGIES 8 hrs

Introduction to CAD. Enabling technologies: Digital twin, AR/VR, AI. Cloud computing, Touch/Voice/Motion enabled CAD, Customized CAD, Cloud based CAD, Digital twin and live simulation.

UNIT 3 SMART MANUFACTURING SYSTEMS 8 hrs

Enabling technologies: AI, Cloud computing, Robotics, IoT. Digital manufacturing: CNC, Cloud based manufacturing, IoT based manufacturing, Advanced CNC programming. Additive manufacturing. Micro electro mechanical systems. Robotics: Robotic automation, Collaborative robots, Autonomous robots, Swarm robots, and Modular robots.

UNIT 4 SMART FACTORY ENABLERS 8 hrs

Enabling technologies. Smart energy: Improving energy efficiency with data, Smart grids. Clean energy. Smart logistics. Smart Inspection. Smart decision making.

UNIT 5 AUTOMOMOUS VEHICLES 8 hrs

Introduction: Traditional mobility versus autonomous driving, Levels of automation, and challenges. Enabling technologies. Self-propelled vehicles, Drones, Unmanned aerial vehicles, Space crafts

UNIT 6 CASE STUDIES 5 hrs

Case studies related to Industry 4.0 applications, such as, transportation, energy, infrastructure, manufacturing, and product design sectors.

Max. 45 Hrs.

COURSE OUTCOMES

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

CO1: Justify how the digitalization technologies are advantageous to the design and manufacturing industries.

CO2: Use the advanced CAD technologies to create the CAD models.

CO3: Use the smart manufacturing technologies to produce the components and products.

CO4: Recommend the enabling technologies to make various factory operations smarter.

CO5: Choose the suitable sensors and technologies to the future autonomous vehicles, drones and space crafts.

CO6: Prepare a report with the challenges faced currently, the enabling technologies to become smarter, and the steps needed for the effective implementation for the given case study.

TEXT / REFERENCE BOOKS

1. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, “Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0”, Automation in Construction, Vol. 103,pp. 251- 267, 2019.
2. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
3. Oliver Grunow, ”Smart Factory and Industry 4.0. The current state of Application Technologies”, Studylab Publications, 2016
4. Alasdair Gilchrist, “Industry 4.0: Industrial Internet of Things”, Apress, 2016
5. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, “Applied Cyber-Physical Systems”, Springer Publications, New York, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A: 11 Questions of 2 marks each - No choice **22 Marks**

PART B: 2 Questions from each unit with internal choice, each carrying 13 marks **78 Marks**

New Course	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

(Use of approved statistical table permitted in the examination)

COURSE OBJECTIVES:

- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES **9Hrs**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES **9Hrs**

Control chart for attributes –control chart for non conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING **9hrs**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY **9Hrs**

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY **9Hrs**

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Course Outcomes: Max. 45 Hours

On completion of the course, student will be able to

CO1: Apply the concept of SQC in process control for reliable component production

CO2: Perform statistical analysis using control charts

CO3: Apply sampling techniques for non conformities

CO4: Evaluate the quality of components by failure analysis

CO5: Design for reliability of component parts

CO6: Develop product analysis for new product development

TEXT BOOKS/ REFERENCES

1. Douglas.C. Montgomery, " Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.
3. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005
4. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993
5. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
6. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
7. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration : 3 Hrs.**
PARTA: 10 questionsof 2 markseach-Nochoice	20 **Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks	80 **Marks**