ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR, GUNTUR – 522 510
ANDHRAPRADESH, INDIA

Syllabus

For

HONORS AND MINORS PROGRAMME

MECHANICAL ENGINEERING

w.e.f.: 2020-2021

Curricular Framework for Honors Programme

1. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.
2. A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA upto the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
3. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from samebranch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
4. In addition to fulfilling all the requisites of a Regular B.TechProgramme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
5. Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific,each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
6. It is the responsibility of the student to acquire/complete prerequisitebefore taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
7. The concerned BoS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
8. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BoS shall

explore the possibility of introducing virtual labs for such courses with lab component. (Model poollist is enclosed in the Annexure-2)

9. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.

10. The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors).However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

11. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass(P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
12. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

13. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

Curricular Framework for Minor Programme:

1. a)Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

   b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.
2. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE,CE,ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science(DS), Robotics, Electric vehicles, Robotics, VLSI etc.
3. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
4. There shall be no limit on the number of programs offered under Minor. The University/Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
5. The concerned BoS shall decide on the minimumenrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
6. A student shall be permitted to register for Minors program at the beginning of 4^{th} semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) upto the end of 2^{nd} semester without any history of backlogs. It is expected that the 3rd semesterresults may be announced after the commencement of the 4^{th}semester. If a student fails toacquire 8 SGPA upto 3^{rd}semester or failed in any of the courses, his registration for Minors programshall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesterswithout any backlog in order to keep the Minors registration active.

7. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
8. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

1. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.
2. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BoS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses froman externalagency recommended and approved byconcerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.
3. A committee should be formedat the level of College/Universities/department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BoS. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.
4. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In suchcases, the student may choose between the actual grade or a “pass(P)” grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the

transcript. None of the courses done under the dropped Minor will be shown in the transcript.

5. In case a student fails to meet the CGPA requirement for B.Techdegree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

6. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

INDUSTRIAL COLLABORATIONS (CASE STUDY)

University-Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Universities in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

The Universities/Institutions (Autonomous) are permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Universities/Institutions can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Universities/Institutions shall also explore the possibilities of collaborations with major Industries in the core sectors and professional bodies to create specialized domain skills.

-oOo-

POOL I-AUTOMOBILE DOMAIN									
S.No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Internal	External	
1	MEH101	Modern Vehicle Technology	Honour	3	0	0	30	70	4
2	MEH102	Automobile Engineering	Honour	3	0	0	30	70	4
3	MEH103	Alternative Energy Source for Automobiles	Honour	3	0	0	30	70	4
4	MEH104	Vehicle Body Engineering	Honour	3	0	0	30	70	4

POOL II-AUTOMATION DOMAIN									
S.No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Internal	External	
1	MEH201	Field & Service Robotics	Honour	3	0	0	30	70	4
2	MEH202	Mechatronics	Honour	3	0	0	30	70	4
3	MEH203	Control Systems	Honour	3	0	0	30	70	4
4	MEH204	CAD/CAM	Honour	3	0	0	30	70	4

POOL III-THERMAL DOMAIN									
S.No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Internal	External	
1	MEH301	Computational Fluid Dynamics	Honour	3	0	0	30	70	4
2	MEH302	Gas Dynamics & Jet Propulsion	Honour	3	0	0	30	70	4
3	MEH303	Alternate fuels & Energy Systems	Honour	3	0	0	30	70	4
4	MEH304	Safety Aspects of Nuclear Power Plants	Honour	3	0	0	30	70	4

POOL IV-PRODUCTION DOMAIN									
S.No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Internal	External	
1	MEH401	Additive Manufacturing	Honour	3	0	0	30	70	4
2	MEH402	Supply Chain Management	Honour	3	0	0	30	70	4
3	MEH403	Flexible Manufacturing Systems	Honour	3	0	0	30	70	4
4	MEH404	Rapid Prototyping	Honour	3	0	0	30	70	4

Note: 1. Students has to acquire 16 credits with minimum one subject from each pool. (04 courses@4 creditseach)

2. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each)

B.Tech (Hons) in Mechanical Engineering

MEH101 MODERN VEHICLE TECHNOLOGY

II Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

1. **Preamble:**

   Thiscoursegivesawideknowledgetothestudentaboutrecentdevelopmenti nvehicletechnology.
2. **Pre requisite:**
   IC Engines
3. **Course Educational Objectives:**
   Studentsundergoingthiscoursareexpectedto
   - To develop therecent trendingknowledgein theAutomobile field.
   - Todevelop theskills ofthestudentsin recentsafetyprecautionprinciples

4. **Course Outcomes**:

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

CO Nos.	CourseOutcomes
C01	KnowtherecentdevelopmentsinAlternatepowergenerationfora vehicle.
C02	Familiarizewithadvancedsuspension,Braking,andSafetysystemsin automobile.
C03	Knowefficient Noiseand pollutioncontrol techniquesin automobiles
C04	KnowtheVariousVehicleoperationandcontrolsystems.
C05	Knowthe Vehicleautomated tracks.

UNIT–I

DRIVERINFORMATIONSYSTEMS

Introduction,DriverSupportSystems–DriverInformation,DriverPerception,DriverConvenience, Driver Monitoring. Vehicle Support Systems – General Vehicle Control, CollisionAvoidance,VehicleStatus Monitoring

UNIT – II

DRIVER ASSISTANCE SYSTEMS

Global Positioning Systems, Geographical Information Systems, Navigation Systems, Automotive Vision System, Road Recognition, Driver Assistance Systems - Connected Vehicles, Autonomous Vehicles

UNIT – III

SAFETY SYSTEMS

Active and Passive Safety Systems, Airbags, Seat Belt Tightening System, Collision Warning Systems, Child Lock, Anti-Lock Braking Systems, Traction Control, Electronic Stability Programme.

Crash Worthiness of Vehicle, Vehicle Crash Testing, Testing With Dummies. Security Systems - Anti Theft Technologies, Smart Card System, Number Plate Coding.

UNIT – IV

COMFORT SYSTEMS

Active Suspension Systems, Requirement and Characteristics, Different Types, Power Steering, Collapsible and Tiltable Steering Column, Power Windows, Biometric Systems. Adaptive Control Systems: Adaptive Cruise Control, Adaptive Noise Control, Anti Spin Regulation.

UNIT – V

ELECTRONIC ENGINE MANAGEMENT

Single Point and Multipoint Injection System, Working of Electronic Fuel Injector, Different Types of Electronic Fuel Injection Systems Like L, K, KE, LU, LH and Motronic, ME & MH Systems, Cylinder Cut-Off Technology.

Text Books

1. K.K. Ramalingam, "Automobile Engineering", Scitech Publications Pvt. Ltd., 2005
2. Crouse/Anglin "Automotive Mechanics"
3. T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited, London, 2005.
4. "Automotive technology " H.Hertz

References

1. Beranek. L.L. Noise Reduction, McGraw-Hill Book Co., Inc, Newyork, 1993
2. Bosch Hand Book, 3rd Edition, SAE,1993

B.Tech (Hons) in Mechanical Engineering

MEH102 AUTOMOBILE ENGINEERING

II Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT I

Introduction: Classification of vehicles – applications, options of prime movers,transmission and arrangements. (4)

Engine: Engine Classifications - number of strokes, cylinders, types of combustion chambers for petrol and diesel engines, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel. (7)

Assorted Equipment: Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps, Air and Fuel Filters, super chargers, Mufflers. (4)

UNIT II

Cooling Systems: Need for cooling system, Air and water cooling. (3)

Lubricating Systems: Various lubricating systems for I.C. Engines. (3)

Electrical System: Ignition system, Spark plugs, Distributor, Electronic Ignition, Alternator, cutout, Current and voltage regulators, charging circuit, starting motors, lighting, instruments and accessories. (9)

UNIT III

Chassis & Transmission Systems: Introduction to Chassis & Transmission, Clutches –Single-plate and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms. (7)

Transmission: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working. (8)

UNIT IV

Suspension Systems: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. (8)

UNIT V

Vehicle Control: steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic). (7)

TEXT BOOKS:

1. Automobile Engineering - G.B.S.Narang.
2. Automobile Engineering - R.B.Gupta
3. Automobile Engineering - Vol I & II - Kirpal Singh

REFERENCE BOOKS:

1. Automotive Mechanics - Joseph Heitner
2. Automobile Engineering - S.Srinivasan

B.Tech (Hons) in Mechanical Engineering

MEH103 Alternative Energy Sources For Automobiles

II Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

Course Objectives

To impart the necessity of finding alternative energy sources for automobiles. To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

Course Outcomes

By the end of this course, students will be able to

1. Student will possess a comprehensive understanding of available alternative fuels for IC engines. They will posses complete knowledge on producing different biofuels, modifyingthem and using them in IC engines
2. Students will acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
3. Students will demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.

Unit-I

CONVENTIONAL FUELS FOR I.C. ENGINES

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil –vehicle population increase –national and international standards for conventional and alternative fuels.Desirable characteristics of SI Engine fuels –Petrol –Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels –Diesel –Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

Unit-II

ALCOHOLS AS FUELS

Availability of different alternative fuels for engines. Alcohols –Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of alcohol fuels

Unit-III

VEGETABLE OILS AND BIODIESEL AS FUELS

Properties of Vegetable oils and biodiesel-Methods of using vegetable oils –Blending, preheating, and emulsification –Preparation of biodiesel from non-edible, edible oil and Algae -Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

Unit-IV

HYDROGEN AS FUEL

Hydrogen –Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

Unit-V

BIOGAS, CNG AND LPG AS FUELS

Biogas, Compressed Natural gas (CNG) and LPG –Properties and production methods. CO_2 and H_2S scrubbing in Biogas, Modifications required for use in Engines-Performance,

combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

Reference Books

1. Arumugam S. Ramadhas, "Alternative Fuels for Transportation" CRC Press, 2011.
2. Ayhan Demirbas and M. Fatih Demirbas, "Algae Energy-Algae as a New Source of Biodiesel", Springer-Verlag London Limited 2010.
3. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008
4. David M. Mousdale, "Introduction to Biofuels", CRC Press, 2015.
5. Ganesan.V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7. M. K. Gajendra Babu and K. A. Subramanian, "Alternative Transportation Fuels-Utilisation in Combustion Engines", CRC Press, 2013.
8. M.L. Mathur, R.P.Sharma "A course in internal combustion engines", Dhanpatrai publication, 2003.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

B.Tech (Hons) in Mechanical Engineering

MEH104 Vehicle Body Engineering

II Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

OBJECTIVE

At the end of the course, the students will be able to have a sound knowledge for the design of the vehicles body to give maximum comfort for the passengers and exposed to the methods of stream lining the vehicles body to minimize drag.

UNIT- I

CAR BODY DETAILS

Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility: regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars. Safety: safety design, safety equipments for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and Instrumentation

UNIT-II

VEHICLE AERODYNAMICS

Objectives. Vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing, component balance to measure forces and moments.

UNIT- III

BUS BODY DETAILS

Types: mini bus, single decker, double-decker, two level and articulated bus. Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction.

UNIT-IV

COMMERCIAL VEHICLE DETAILS

Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Dimensions of driver's seat relation to controls. Drivers cab design.

UNIT –V

BODY MATERIALS, TRIM AND MECHANISMS

Steel sheet, timber, plastic, GRP, properties of materials; Corrosion, anticorrosion methods. Selection of paint and painting process. Body trim items. Body mechanisms.

TEXT BOOK

1. J.Powloski - "Vehicle Body Engineering" - Business Books Ltd, London -1989

REFERENCES

1. Giles.J.C. - "Body construction and design" - Liiffe Books Butterworth & Co. - 1971. 2. John Fenton - "Vehicle Body layout and analysis" - Mechanical Engg. Publication Ltd., London – 1982.

3. Braithwaite.J.B. - "Vehicle Body building and drawing" - Heinemann Educational Books Ltd., London – 1977.

B.Tech (Hons) in Mechanical Engineering

MEH201 Field & Service Robotics

III Year B.Tech. (Mech) First Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

Course Outcome:

Upon completion of the course, the student should be able to:

- Explain the basic concepts of working of robot
- Analyze the function of sensors in the robot
- Write program to use a robot for a typical application
- Use Robots in different applications
- Know about the humanoid robots.

Unit I

Introduction

History of service robotics- Present status and future trends-Need for service robots- applications –eamples and specifications of service and field Robots. Non-Conventional Industrial robots.

Unit II

Localization

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based LocalizationMonte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

Unit III

Planning and Navigation

Introduction-Path planning overview- Road map path planning- Cell decomposition path planningPotential field path planning-Obstacle avoidance – Case studies: tiered robot architectures.

Unit IV

Ariel robots-Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, Space applications

Unit V

Humanoids:

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

Text Books:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, Bradford Company Scituate, USA, 2004
2. Riadh Siaer, The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

References:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, “Field and Service Robotics “, Springer, 2011

B.Tech (Hons) in Mechanical Engineering

MEH202 Mechatronics

III Year B.Tech. (Mech) First Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

UNIT – I

Introduction to Mechatronics: sensors & transducers: Introduction, performance terminology, classification of sensors, terminology, classification of sensors, selection of sensors. (5)

Signal Conditioning: Introduction data acquisition – Quantizing theory, analog to digital conversion, digital to analog conversion. (5)

Data Presentation Systems: Data presentation elements magnetic displays, data acquisition systems, systems measurement, testing and calibration. (5)

UNIT – II

Actuation Systems: Pneumatic and hydraulic actuation systems, stepper motors. (7) **System Models:** Modeling of one and two degrees of freedom mechanical, electrical, fluid and thermal systems. Block diagram representations for these systems. (8)

UNIT– III

Dynamic Response of systems zero order, First order and second order systems. Block diagram representation, Transfer function. Systems in series, Systems with feed back loops, frequency response. (7)

Closed Loop Controllers: Continuous and discrete processes, control modes, two step, proportional, derivative, integral, PID controllers. (8)

UNIT – IV

PLC : Introduction, basic structure, I/P, O/P, processing, programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output selection of PLC. (7)

UNIT – V

Design: Designing mechatronics systems, possible design solutions, case studies of mechatronics systems-pick and place robot. (8)

TEXT BOOK:

1. Mechatronics by W.Bolton (Pearson)

REFERENCE BOOKS:

1. Mechatronics by Mahalik
2. Introduction to Mechatronics – David and Alcaitore Michael B.Histand (TMH)
3. Mechanical Measurement – D.S.Kumar.
4. Mechatronics ByG.Onwubolu -Elsevier.
5. Mechatronics system Design – Devdasshetty& Richard Kolk (Thomson)

B.Tech (Hons) in Mechanical Engineering

MEH203 Control Systems

III Year B.Tech. (Mech) First Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT – I

Introduction: Concept of control system, Classification of control systems – Open loop and closed loop control systems, Differences, Examples of control systems- Effects of feedback, Feedback Characteristics. Transfer Function Representation: Block diagram algebra, Determining the Transfer function from Block Diagrams, Signal flow graphs(SFG) – Reduction using Mason's gain formula- Transfer function of SFG's.

UNIT – II

Time Response Analysis: Standard test signals, Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications, Steady state response, Steady state errors and error constants.PID controllers: Effects of proportional derivative, proportional integral systems on steady state error.

UNIT – III

Stability Analysis in S-Domain: The concept of stability – Routh-Hurwitz's stability criterion – qualitative stability and conditional stability – Limitations of Routh-Hurwitz's stability. Root Locus Technique: Concept of root locus – Construction of root locus.

UNIT – IV

Frequency Response Analysis: Introduction, Frequency domain specifications, Bode plot diagrams-Determination of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots.

UNIT – V

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, Derivation of state models from block diagrams, Diagonalization, Solving the time invariant state equations, State Transition Matrix and it's properties, Concepts of Controllability and observability.

Reference Books

1. Control Systems Theory and Applications – S. K. Bhattacharya, Pearson.
2. Control Systems Engineering – S. Palani, TMH.
3. Control Systems – N. K. Sinha, New Age International (P) Limited Publishers.
4. Control Systems by S.Hasan Saeed, KATSON BOOKS.
5. Solutions and Problems of Control Systems by A.K. Jairath, CBS Publishers.

B.Tech (Hons) in Mechanical Engineering

MEH204 CAD/CAM

III Year B.Tech. (Mech) First Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

Course Objectives

To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

Course Outcomes

Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces. Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM – Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure. Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT – II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface.
B-splinesurface, Regenerativesurface and pathological conditions.
Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems. Computer aided manufacturing resource planning: Material resource planning, inputs to

MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.
Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.
Computer Integrated Manufacturing: CIM system, Benefits of CIM

Text Books

1.CAD/CAM Concepts and Applications / Alavala / PHI
2.CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

Reference Books

1.CAD/CAM/ Groover M.P/ Pearson
2.CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

B.Tech (Hons) in Mechanical Engineering

MEH301 Computational Fluid Dynamics

III Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

COURSE OBJECTIVES:

1. To know the various applications of CFD and basic governing equations of fluidflow 2. To know the classification of PDE and discretizationtechniques 3. To know the implicit and explicit methods and VN stability criteria for parabolic and hyperbolic equations 4. To know different CFD techniques

COURSE OUTCOMES:

1. Understand the philosophy of CFD and derive governing equations of fluidflow 2. Understand the principles ofdiscretization. 3. Formulate solution techniques for parabolic and hyperbolicequations. 4. Apply some of the popular FD techniques in the solution of fluid flowproblems

UNIT-I

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler‟s equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions

UNIT-II

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT -III

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT -IV

Simple CFD techniques: Lax-Wendroff technique, MacCormack‟s technique and Iterative and Relaxation techniques.

UNIT -V

Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method. Commercial CFD software packages and applications of CFD.

TEXT BOOK(S):

1. Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition2012.
2. Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

REFERENCE BOOK(S):

1. Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2. Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1stEdition.
3. Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition,2003.

WEB REFERENCE:

1.http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigalfluidmechanicsfall2011/
2. http:/inptel.ac.in/courses/112105045/ (IITKharagpur)
3. http://nptel.ac.in/courses/112107080/ (IITRoorkee)
4. http://nptel.ac.in/courses/112104030/ (IITKanpur)

MEH302 Gas Dynamics & Jet Propulsions

III Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*: 3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*: 3 hrs.*	*University Exam. Marks*	*: 70*

COURSE OBJECTIVES:

1. To understand the behaviour of compressible fluid & Governing equations.
2. To understand the Non-isentropic flow behaviour.
3. To understand the principle of Jet Propulsion and Working Principles of various jet engines.
4. To understand the working principle of rocket engine and its propellants.

COURSE OUTCOMES:

1. Able to analyse the isentropic compressible flow systems.
2. Able to analyse the non-isentropic compressible flow.
3. Able to estimate the Thrust, Power and various efficiencies of Jet Propulsion units.
4. Able to analyse the rocket engines

UNIT-I

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers.

UNIT-II

Subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow. Applications, advantages and disadvantages of Supersonics and Subsonic flows

UNIT-III

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT -IV

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -V

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, spaceflights.

TEXT BOOK(S):

1. Gas Dynamics and Jet Propulsion --- P.L.Somasundaram
2. Gas Dynamics - E.Radhakrishnan

REFERENCE BOOK(S):

1. Gas Dynamics - JohnJames
2. Fundamentals of Gas Dynamics - Chen, ReceyHung

WEB REFERENCES:

1. https://lecturenotes.in/video-tutorial/63871-gas-dynamics-andpropulsion?reading=true
2. https://www.youtube.com/watch?v=2INUkeutjBY&list=PLbMVogVj5nJR0V t9CLGK7ck2yrS1zQjMo
3. https://www.youtube.com/watch?v=lPoU8Cu9ffw&list=PLY6be7r7PT8Jec yts018SmNqWPMA-JpQA
4. https://www.youtube.com/watch?v=csxn_ek8HSE

5. https://www.youtube.com/watch?v=xSpqILSumek

B.Tech (Hons) in Mechanical Engineering

MEH303 Alternate Fuels & Energy Systems

III Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

COURSE OBJECTIVES:

1. To know about the different fuels and the required qualities to use as engine fuels,potential alternative fuels, their merits and demerits.
2. To Understand the need for alternative fuels, availability of different alternative fuels for both SI and CI engines and t the suitability of alcohols as fuels for both SI and CI engines.
3. To know about the suitability of Hydrogen as a fuel for both SI and CI engines, different production methods along with storage and safety aspects of Hydrogen and toknow about the different vegetable oils suitable as fuels 4. To know about the working of electric, hybrid and fuel cell vehicles.

COURSE OUTCOMES:

1. Able to understand the different fuels and required qualities to use as fuels for IC engines and potential alternative fuels along with their merits and demerits.
2. Abe to understand the need for alternative fuels, availability of different alternative fuels to and suitability of alcohols as fuels for both SI and CI engines
3. Able to understand the suitability of Hydrogen as a fuel for both SI and CI engines, production, storage and safety of Hydrogen along with different vegetable oils suitable for both SI and CI engines.
4. Able to understand the working of Electric, Hybrid and Fuel cell vehicles, their relative merits and limitations in using them.

UNIT-I

Introduction: solid fuels, gases fuels, liquid fuels, petroleum refining process, important requisite qualities of engine fuels, SAE rating of fuels. FUELS: Availability and Suitability to Piston Engines.Concept of conventional fuels, potential alternative fuels - Ethanol, Methanol, DEE/DME .

UNIT-II

Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C.Engines-Merits and Demerits of various fuels. Application, advantages & Disadvantages of alternate fuels.

UNIT-II

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives.

UNIT-III

GASEOUS FUELS: Hydrogen - Properties - Use in C.I Engines - Use in S.I Engines - Storage methods - Safety precautions -Production methods. LPG & Natural gas - Properties - Use in S.I. and C.I. Engines. VEGETABLE OILS: Properties - Esterification - Performance in Engines.

UNIT-IV ELECTRIC, HYBRID AND FUEL CELL VEHICLES Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

TEXT BOOK(S):

1. S.S. Thipse, "Alternative Fuels", Jaico Publishing House; First edition,2010.
2. Erjavec Jack Et.Al, "Alternative Fuel Technology: Electric, Hybrid, and Fuel-Cell Vehicles",Cengage Learning,2007.

REFERENCE BOOK(S):

1. Ganesan. V."Internal Combustion Engines", Tata McGraw-Hill Publishing Co,2012.
2. Mathur D.S., Sharma. R.P. "A course in internal combustion engines", Dhanpatrai publication, 2014.

WEB REFERENCE:

1. https://scholarworks.umt.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1296&context=syllabi
2. NPTEL-https://nptel.ac.in/courses/121/106/121106014/
3. https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture39.pdf

B.Tech (Hons) in Mechanical Engineering

MEH304 Safety Aspects of Nuclear Power Plants

III Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

Course Objectives:
This course enables the students to:
1. Familiarize the students on the future benifits of Nuclear power plants.
2. Develop an intuitive understanding of safety of Nuclear power plants
3. Study the regulatory approaches adopted, which assures the safety of NPP.

Course Outcomes:
At the end of the course, a student should be able to:
1 Outline the basic concept of Nuclear reactors.
2 Analyse the various Radiation sources and Protection of NPP
3 Analyze the safety principles.
4 Evaluate and Analyze some events in NPP and Sitings of Nuclear plants
5 Analyze the safety regulations in india

UNIT-I
Introduction: Energy sources, Nuclear Power Production, medical and Societal applications of radiation, Nuclear fuel cycle. Basic Physics of Nuclear Reactors: Atomic Structure, isotopes, Radioactivity, half life, Basics of fission reaction, Moderation, Criticality, Decay heat, Reactivity and Feedback, Breeding.

UNIT-II
Nuclear Reactor Types: Components of Nuclear Reactor, Present Reactor Types, Generation IV Concepts. Radiation sources and Protection: Radiation and its units, Natural background and manmade Radiation, Biological Effects, Exposure limits and protection, Sources of radiation, shielding.

UNIT-III
Safety Principles and approach: Safety objectives, Defence in depth philosophy, Multiple barriers, Rad-waste management, Levels of defence, Redundancy, Diversity Principles, Event analysis, core inventory, emergency response. Deterministic approach- Design Basis Events & Beyond Design Basis Events, Acceptance Criteria, Probabilistic approach- Fault tree, event tree, failure rates. Engineered Safety Systems: Shutdown systems in PWR, BWR,PHWR, Reactivity Worth of shutdown system, Trip Signals, Safety Logic, Operating Environment, Grouping of safety systems, Heat Removal systems, Emergency Core Cooling, Containment and subsystems.

UNIT-IV
Analysis of Some Events in NPP: Heat transfer and Fluid flow prediction, validation, Safety set points, Safety actions for events, Spurious opening of Pressuriser valve in a PWR, LOCA analysis Indian PHWR, Station Blackout without Reactor Trip, FBTR. Siting of Nuclear plants: Site evaluation Stages, Site Rejection Criteria, Earthquake, Geological criteria, Meteorological considerations, Flooding, Tsunami, Shoreline erosion, chemical explosion, Radiological impact study, Radioactivity pathways to humans, environmental Impact study. (

UNIT-V

Safety Regulation In India: Atomic Energy Regulatory Board, functions, safety Documents, Safety Review of site, design, regulatory inspections, safety review for PFBR, Koodankulam, Regulatory review of operating plants, Licensing stages, licensing of operating personnel, Training simulator, safety up-gradation Review after TMI Chernobyl, Review after Fukushima, safety review for decommissioning, Safety Review of Radiation Facilities, medical X-ray units, Gamma irradiators.

Text Books

1. G. Vaidyanathan, Nuclear reactor Safety- principles and concept, Yes Dee Publishing, 2017.

Reference Books

1. Samuel Glasstone, Nuclear Reactor Engineering, CBS Publishers & Distributors, 2004.
2. John R. Lamarsh, Introduction to Nuclear Engineering, Pearson Education India, 2014.

B.Tech (Hons) in Mechanical Engineering

MEH401 Additive Manufacturing

IV Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

Course Objectives:

1. To provide the basics of Additive manufacturing Process
2. To give an idea of Reverse Engineering concept in the present scenario.
3. To provide knowledge on types of Additive manufacturing techniques
4. To introduce to and development of new tooling techniques for manufacturing.

Course Outcomes The students will be able to

1. Understand concepts and terminology of additive manufacturing
2. Apply the reverse engineering concepts for design development
3. Understand the variety of additive manufacturing techniques
4. Design and develop newer tooling models

UNIT-I

Introduction: Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Advantages and Applications.

UNIT-II

Reverse Engineering and CAD Modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation- Software for AM.

UNIT-III

Tooling: Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling. Liquid Based Additive Manufacturing System: Stereo-lithography Apparatus (SLA): Principle, pre- build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoats issues, materials, advantages, limitations and applications.

UNIT-IV

Solid Based Additive Manufacturing System: Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM)-Principle, details of process, process variables, products, materials and applications. Laminated Object Manufacturing (LOM)-Working Principle, Details of processes, materials, advantages, limitations and applications.

UNIT-V

Powder Based Additive Manufacturing System: Selective Laser Sintering (SLS)-Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS)-Processes, materials, advantages, limitations, Applications.

REFERENCE BOOKS

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers,2010.
2. Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications,2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer,2010.
4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.14 5. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer,2006.
6. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press,2011.

B.Tech (Hons) in Mechanical Engineering

MEH402 Supply Chain Management

IV Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*: 70*

COURSE OBJECTIVES:

1. Understand the basic concepts of Supply Chain Management and identify SC drivers.
2. Discuss the role of supply chain network.
3. Know the importance of logistics in SCM
4. Learn about aggregate planning and coordination concepts of SCM.

COURSE OUTCOMES:

After completion of the course, the students will be able to

1. Understand the decision phases and apply competitive & supply chain strategies.
2. Analyze factors influencing network design.
3. Analyze the influence of logistics in a supply chain.
4. Understand the role of aggregate planning, inventory, IT and coordination in a supply chain

UNIT-I

Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope. Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

UNIT-II

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

UNIT-III

Logistics in supply chain: Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT-IV

Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Coordination in SC:

UNIT-V

Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect.

TEXT BOOK(S):

1. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia,2010.
2. David Simchi-Levi, PhilpKamintry and Edith Simchy Levy, Designing and Managing the SupplyChain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill,2000.

REFERENCE BOOK(S):

1. Jeremy F.Shapiro, “Modeling the Supply Chain”, Thomson Duxbury,2002.
2. Srinivasan G.S, “Quantitative models in Operations and Supply Chain Management, PHI,2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, “Logistics”, PHI2002.
4. James B.Ayers, “Handbook of Supply Chain Management”, St.Lucle press,2000

B.Tech (Hons) in Mechanical Engineering

MEH403 Flexible Manufacturing Systems

IV Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

OBJECTIVES:

At the end of this course the student should be able to understand Modern manufacturing systems

To understand the concepts and applications of flexible manufacturing systems

UNIT I

PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS :Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

UNIT II

COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLEMANUFACTURING SYSTEMS :Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

UNIT III

FMS SIMULATION AND DATA BASE :Application of simulation–model of FMS– simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

UNIT IV

GROUP TECHNOLOGY AND JUSTIFICATION OF FMS :Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification.

UNIT V

APPLICATIONS OF FMS AND FACTORY OF THE FUTURE: FMS application in machining, sheet metal fabrication, prismatic component production –aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

TEXT BOOK

1. Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc.,1991.

REFERENCES

1. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd.,New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing

Co., 1995.
5. Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 1992.

B.Tech (Hons) in Mechanical Engineering

MEH404 Rapid Prototyping

III Year B.Tech. (Mech) Second Semester

Lectures / Tutorials	*:*	*3 Periods / week*	*Sessional Marks*	*:*	*30*
University Exam.	*:*	*3 hrs.*	*University Exam. Marks*	*:*	*70*

Unit - I

INTRODUCTION:

Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process. LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modeling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Unit - V

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats. RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

Text Books

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.

Reference Books

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.
3. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press.

MINORS IN MECHANICAL ENGINEERING									
Eligibility: Students of all branches Except Mechanical Engineering									
S.No.	Course Details		Category	Scheme of Instruction			Scheme of Examination		
	Code	Subject Name		Hours in a Week			Marks		Credits
				L	T	P	Internal	External	
1	MEM01	Basic Mechanical Sciences	Minors	3	0	0	30	70	4
2	MEM02	Thermal Engineering	Minors	3	0	0	30	70	4
3	MEM03	Production Technology	Minors	3	0	0	30	70	4
4	MEM04	Fundaments of Engineering Design	Minors	3	0	0	30	70	4
5	MEM05	Production Planning & Control	Minors	3	0	0	30	70	4
6	MEM06	Metallurgy and Material Science	Minors	3	0	0	30	70	4

B.Tech (Minors) in Mechanical Engineering

MEM01 BASIC MECHANICAL SCIENCES

Lectures / Tutorials :	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam. :	*3 hrs.*	*University Exam. Marks*	*: 70*

Unit – I

Transmission of Motion and Power

Introduction, Methods of drive, Power transmission elements, shaft and axle, Belt-drive, Pulleys, Power transmitted by a belt, Chain drive, Friction drive, Gear drive

Governors

Introduction, Speed Control, Types of Governors, Watt Governer, Porter Governer, HartnellGoverner

Unit – II

Basic Thermodynamics: Work, Power, Energy, Heat, Temperature, Mechanical equivalent of heat, Internal energy, Enthalpy, Entropy, Efficiency, Statements of Zeroth law, First Law and Second Law of Thermodynamics

Unit – III

Internal Combustion Engines

Introduction, Classification, Engine details, Otto four-stroke cycle, Diesel-four-stroke cycle, Difference between Otto cycle and Diesel cycle, Two-stroke cycle, Difference between two-stroke and four-stroke cycles, Indicated Power (ip), Brake Power (bp),Efficiencies

Unit – IV

Steam Boilers

Introduction, Classification, Simple vertical boiler, Vertical multi tubular boiler, Cochran type, Lancashire boiler, Locomotive boiler, Babcock and Wilcox boiler, High pressure boilers, Boiler details, Boiler performance. Functioning of different mountings like Pressure guage, Water level indicator, Safety Valve etc. and Accessories like Feed Pump, Injector, Economizer, Steam trap etc.

Refrigeration & Air Conditioning

Introduction, Refrigerant, Types of refrigerators, Vapor compression refrigerating system, Window and split-air conditioners.

Unit – V

Pumps

Introduction, Reciprocating pump types, operation, Air Chamber, Centrifugal pumps types, Priming, Rotary pumps.

Air Compressors

Introduction, Uses of Compressed air, Reciprocating compressors, Operation of a compressor, Work for compression, Power required, Reciprocating compressor efficiency, Multistage reciprocating compressors, Rotary compressors.

TEXT BOOKS

1. Elements of Mechanical Engineering , by Rajput ,Laxmi Publications, New Delhi
2. Elements of Mechanical Engineering by K.P. Roy , Media Promoters
3. Thermal Engineering – by Rajput, Laxmi Publications, New Delhi
4. Theory of Machines , by R.S. Khurmi& Gupta, S.Chand Publishers
5. Elements of Mechanical Engineering -- by K.P. Roy , Media Promoters

Code No: MEM01

B. Tech(Minors)

BASIC MECHANICAL SCIENCES

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

B.Tech (Minors) in Mechanical Engineering

MEM02 Thermal Engineering

Lectures / Tutorials :	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam. :	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT I

Fundamental Concepts and Definitions: Introduction, Macroscopic and microscopic points of view, Thermodynamic system and control volume, Perfect gases, properties and state of a substance, Thermodynamic equilibrium and Quasi-static Process, thermodynamic path, reversible and irreversible processes, factors that render a process irreversible, cycle, Zeroth law of thermodynamics, concept of temperature. (8)

Work and Heat: Definitions and units, system, closed system, open system, surrounding, universe, Work done at the moving boundary of a system,Work done in various non-flow processes, comparison of heat and work.(4)

UNIT II

First Law of Thermodynamics for Non-Flow Systems: First law for a system undergoing a cycle and for a change in state of system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases. (8)

First Law of Thermodynamics for Flow Systems*:* Control mass and control volume, first law of thermodynamics for a control volume, Steady flow energy equation and itsApplication to engineering equipment. (4)

UNIT III

Second Law of Thermodynamics: Limitations of first law, PMM of first kind**,** Heat engines and Refrigerators, Statements of Second law, PMM of second kind, Carnot cycle and Carnot theorems, Thermodynamic temperature scale. (8)

Pure Substance: Definition**,** process of steam generation, P-v, T-s and h-s diagrams,Properties of saturated and superheated steam,Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction (4)

UNIT IV

Vapor Power Cycles: Rankine cycle, Effect of pressure and temperature on the Rankinecycle, reheat cycle, regenerative cycle. (8)

Steam Boilers: Function, classification, working of Babcock and Wilcox boiler, Mountings &Accessories.(4)

UNIT V

Introduction: Basic Modes and Laws of Heat transfer, thermal conductivity, Steady stateHeat Conduction, General conduction equation in Cartesian, Cylindrical and Sphericalcoordinates, initial and boundary conditions. (5)

One-Dimensional Steady State Heat Conduction: Heat flow through plane wall andcylinder with constant thermal conductivity, Heat flow through composite slab and Cylinders, Thermal resistance, Electrical analogy, Thermal contact resistance, problems on variablethermal conductivity, critical insulation thickness, uniform heat generation in slabs.(8)

TEXT BOOKS

1. Thermal Engineering ---Rajput, LaxmiPubl, New Delhi.
2. Thermal Science and Engineering- D.S.kumar, S.K.katariaPubl, New Delhi.
3. Heat and Mass Transfer – Sachdeva, New Age India, New Delhi
4. Heat Transfer—Rajput, Laxmipubl, New Delhi.

Code No: MEM02

B. Tech(Minors)

THERMAL ENGINEERING

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

B.Tech (Minors) in Mechanical Engineering

MEM03 PRODUCTION TECHNOLOGY

Lectures / Tutorials :	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam. :	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT I

Metal Casting: Introduction, advantages of Casting method, pattern: types, materials and allowances. Sand moulding procedure, Moulding materials and equipment. Preparation, control and testing of moulding sands.Cores, Cupola: Description, operation and zones. (12)

Gating Design: Design Considerations

Special Casting Methods: Permanent Mould Casting, Die Casting, Centrifugal casting, Investment casting, shell moulding, CO_2 process and continuous casting. Fettling of castings, casting defects : causes, remedies and testing.(12)

UNIT- II

WELDING: Gas and arc welding - Principles of oxy-acetylene welding, oxyacetylene flame cutting, MMAW(Manual metal arc welding), TIG, MIG, submerged arc welding. Resistance welding principles - Butt welding, Spot welding, Seam welding. Thermit Welding, Electro slag welding. Laser beam welding. Brazing & Soldering, welding defects - causes and remedies.(12)

UNIT- III

Metal Working Processes: Introduction, Hot and Cold working of metals.

Rolling : Types of rolling mills, roll passes

Forging : Types, description and types of forging, defects in forged parts.

Extrusion : Classification, description and application of extrusion process Tube making, Swaging Spinning, Coining, Embossing and Wire drawing

Explosive forming and electro hydraulic forming.(12)

UNIT- IV

Machining Processes and Machine Tools: Introduction, Primary and Auxiliary Motions in machine tools, parameters defining working motions of a machine tool. (3)

Lathe: Constructional details, specifications, classification of lathes**. (3)**

Lathe Mechanisms: Spindle speed Mechanisms in Belt driven and All Geared Head stock,Apron and Half-nut mechanisms. Lathe accessories – various work holding devices. Lathe operations including taper turning and thread cutting and related problems. (9)

UNIT- V

Drilling Machines: Types and specifications, spindle feed mechanism, drilling operations, drilling time. (4)

Shaping and Planing: Constructional details, types of shapers and planers, specifications, Quick Return Mechanism and automatic feed mechanisms. (4)

Grinding Machines: General Principles, Wheel materials, Selection and specification of grinding wheels, Truing and Dressing of grinding wheels, types of grinding machines. (7)

Surface Finishing Operations: Honing and Lapping operations. (3)

TEXT BOOKS

1. Manufacturing Technology-Vol- I by PN Rao,TMH
2. Workshop Technology Vol.1 by S.K.HazraChowdary. Khanna Publishers
3. A course in Work shop technology, Vol-I by B.S.Raghuvanshi, Dhanpatrai& Sons.
4. Workshop Technology Vol. II by HazraChowdary
5. Production Engineering by P.C. Sharma, S.Chand& Co

Code No: MEM03

B. Tech(Minors)

PRODUCTION TECHNOLOGY

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

B.Tech (Minors) in Mechanical Engineering

MEM04 Fundaments of Engineering Design

Lectures / Tutorials :	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam. :	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT I

Introduction: Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double – Slider Chain.(6)

Instantaneous centre: Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method. (6)

UNIT II

Dynamic Force Analysis : Introduction, D'Alembert's Principle, Equivalent Offset Inertia Force, Dynamic Analysis of Slider - Crank mechanism (Using Analytical method) Velocity and Acceleration of piston, Angular velocity and Angular Acceleration of Connecting Rod, Piston Effort (Effective Driving Force), Crank Effort. Turning Moment on Crankshaft, Inertia of connecting Rod. , Turning Moment diagrams, Fluctuation of energy and Flywheels

UNIT III

Basics: Basic procedure of machine design, requirements and design of machine elements, traditional design methods. Design synthesis, use of standards in design, manufacturing considerations in machine design, preferred numbers and significance. (6)

Materials & their Properties : Mechanical properties of materials, Common engineering materials and their properties. (4)

Design for Static Strength : Simple Stresses - Combined stresses - Torsional and Bending stresses - stress strain relation, various theories of failure - Factor of safety and its importance in design. (5)

UNIT IV

Design for Fatigue Strength : Stress concentration, stress concentration factors, reduction of stress concentration, fluctuating stresses, fatigue failure, endurance limit, low cycle and high cycle fatigue, notch sensitivity, endurance – approximate estimation, reversed stresses – design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, modified Goodman diagrams, Gerber equation, fatigue design under combined stresses, impact stresses. (9)

UNIT V

Belt Drives : Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of V-belts – Selection of Pulleys.(11)

CHAIN DRIVES: Introduction, Chain drives, Advantages of chain drives over belt drives, Polygonal effect, Selection of roller chains.

TEXT BOOKS:

1. Design of machine elements by Bhandari, Tata McGraw Hill book Co.
2. Machine Design by P.C. Sharma & D.K. Agarwal.
3. Design of Machine Elements by Sharma & Purohit ,PHI
4. Theory of Machines by S.S. Rattan

HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

1. Design data book, P.S.G. College of Technology, Coimbatore
2. Design data book, Mahadevan &Balaveera Reddy - CBS Pub.

Code No: MEM04

B. Tech(Minors)

FUNDAMENTALS OF ENGINEERING DESIGN
Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

B.Tech (Minors) in Mechanical Engineering

MEM05 Production Planning & Control

Lectures / Tutorials :	*3 Periods / week*	*Sessional Marks*	*: 30*
University Exam. :	*3 hrs.*	*University Exam. Marks*	*: 70*

UNIT I

INTRODUCTION: Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Organization of production planning and control department Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions (12)

UNIT II

Project Planning through networks: Arrow (Network) diagram representation, rules for constructing an arrow diagram, PERT, CPM, Critical path calculations, Determination of critical path, Determination of floats, Probability considerations in project.(12)

UNIT III

Introduction to Crashing Materials Management, inventory control and MRP: Functions of materials management, inventory control, Inventory control techniques - ABC, VED and FSN analysis. Materials requirement planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials, MRP logic. (12)

UNIT IV

Aggregate planning: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning methods, mathematical planning models, theoretical planning models (LDR) and heuristic and computer search models, problems. Master Production Schedule; Master Schedule formation – inputs and outputs Routing: Routing procedure – Route sheets– Factors affecting routing. (12)

UNIT V

Scheduling –definition –Difference with loading, Scheduling and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson‘s rules. Dispatching – activities of dispatcher – dispatching procedure – follow up –definition – for existence of functions – types of follow up, applications of computer in production planning and control. (12)

TEXT BOOK(s):

1. Elements of Production, Planning and Control by Samuel Eilon
2. Operations management by Joseph G.Monks,Tata McGraw-Hill Inc,

REFERENCE BOOK(s):

1. Production and Operations management by R.Pannerselvam,PHI, 2nd edition, 2006.
2. Production and Operations Management by S.N.Chary, TMH(4th edition).
3. Production Planning and Control, Mukhopadyay, PH

Code No: MEM05

B. Tech(Minors)

MEM05 Production Planning & Control
Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

B.Tech (Minors) in Mechanical Engineering

MEM06 Metallurgy and Material Science

Lectures / Tutorials : 3 Periods / week Sessional Marks : 30

University Exam. : 3 hrs. University Exam. Marks : 70

UNIT I

Crystallography: Classification of crystals – Bravi's lattices – Miller Indices – Packing factor in cubic systems – coordination number – crystal imperfections – crystal deformation – Slip and Twinning. (6)

Phase Diagrams: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, concept of Ternary diagrams. (6)

UNIT II

Heat Treatment of Steels: Iron–Iron carbide equilibrium diagram, TTT diagrams for eutectoid, hypo and hyper eutectoid steels, martensite and bainitic transformation. (6)

Heat Treatment: Annealing, normalizing, hardening, tempering, surface hardening, age hardening, austempering, martempering and hardenability concept and experimental determination. (6)

UNIT III

Strengthening Mechanisms: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening. (6)

Composite Materials: Properties and applications of Particulate-reinforced composites, fibre reinforced composites, Laminar composites and metal matrix composites. (6)

UNIT – IV

Powder Metallurgy: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy. Forming and shaping of plastics – Extrusion and Injection moulding. (12)

UNIT – V

Ferrous And Non Ferrous Materials: Composition, properties and application of ferrous and non ferrous metals and their alloys. Brief study of cast iron, steels, copper, aluminum, Nano materials – Introduction and Applications (12)

TEXT BOOKS:

1. Introduction to Physical Metallurgy - Avner, McGrawHill
2. Material Science and Metallurgy - V. Raghavan, Pearson Education / PHI.
3. Material Science and Metallurgy - R.B.Choudary - Khanna Pub.

REFERENCE BOOK:

1. Material Science and Metallurgy - Dr.V.D.Kodgire, Everest Publishers
2. Nano materials – J.Dutta & H.Hofman
3. Manufacturing Engineering & Technology – Kalpak Jain & Schmid, Pearson / PHI

Code No:MEM06

B. Tech(Minors)

Metallurgy and Material Science
Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH101

B. Tech(Honors)

Modern Vehicle Technology

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH102

B. Tech(Honors)

Automobile Engineering

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH103

B. Tech(Honors)

Alternative Energy Source for Automobiles

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH104

B. Tech(Honors)

Vehicle Body Engineering

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH201

B. Tech(Honors)

Field & Service Robotics

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH202

B. Tech(Honors)

Mechatronics

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH203

B. Tech(Honors)

Control Systems

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH204

B. Tech(Honors)

CAD/CAM

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH301

B. Tech(Honors)

Computational Fluid Dynamics

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH302

B. Tech(Honors)

Gas Dynamics & Jet Propulsion

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH303

B. Tech(Honors)

Alternate Fuels & Energy Systems

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH304

B. Tech(Honors)

Safety Aspects of Nuclear Power Plants

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH401

B. Tech(Honors)

Additive Manufacturing

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH402

B. Tech(Honors)

Supply Chain Management

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH403

B. Tech(Honors)

Flexible Manufacturing Systems

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		

Code No: MEH404

B. Tech(Honors)

Rapid Prototyping

Mechanical Engineering

Time: 3 Hours **Max. Marks: 70**

Answer any FIVE Questions One Question From Each Unit, Each question carries 14 marks including a & b
All Questions Carry Equal Marks

UNIT-I			
1.	a	Type question here	
	b		
OR			
2.	a		
	b		
UNIT-II			
3.	a		
	b		
OR			
4.	a		
	b		
UNIT-III			
5.	a		
	b		
OR			
6.	a		
	b		
UNIT-IV			
7.	a		
	b		
OR			
8.	a		
	b		
UNIT-V			
9.	a		
	b		
OR			
10.	a		
	b		