RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS
Mechatronics Engineering
IV Year B.Tech. : VII Semester

7MH1: MICRO ELECTRO MECHANICAL SYSTEMS

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
INTRODUCTION
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT 2
SENSORS AND ACTUATORS
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT 3
SENSORS AND ACTUATORS-II
Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT 4
MICROMACHINING
Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies – Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process – Assembly of 3D MEMS – Foundry process.

UNIT 5
POLYMER AND OPTICAL MEMS
Polymers in MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TEXT BOOKS

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES

1. NadimMaluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

7MH2: MEDICAL ELECTRONICS

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
INTRODUCTION
Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential– electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

UNIT 2
TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION
Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fibre-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT 3
SIGNAL CONDITIONING, RECORDING AND DISPLAY
Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Ampelectrometer amplifier, carrier Amplifier – instrument power supply. Oscillagraphic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC
writing systems – Telemetry principles – Bio telemetry.

UNIT 4
MEDICAL SUPPORT
Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anaesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIT 5
BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION
Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis.

REFERENCES
1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TMH, 1989.
2. Arumugam M., “Bio Medical Instrumentation”, Anuradha agencies Pub., 2002.
3. Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, 3rd Edition, John Wiley and Sons, 1995.
4. Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd Edition, Prentice Hall of India, 1999.
5. Tompkins W.J., “Biomedical Digital Signal Processing”, Prentice Hall of India, 1998.

7MH3: ROBOTICS AND MACHINE VISION SYSTEM

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
BASICS OF ROBOTICS
Introduction- Basic components of robot-Laws of robotics- classification of robot-work spaceaccuracy- resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives

UNIT 2
ROBOT END EFFECTORS
Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

UNIT 3
ROBOT MECHANICS
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning.
Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT 4
MACHINE VISION FUNDAMENTALS
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding-edge detection- binary morphology - grey morphology

UNIT 5
ROBOT PROGRAMMING
Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

REFERENCES
1. SathyaRanjan Deb, robotics Technology & flexible Automation Sixth edition, Tata Mcgraw-Hill Publication, 2003.
2. GordenM.Dair, Industrial Robotics, PHI 1988.
3. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, Robotics: Sensing, Vision& Intelligence, Tata Mcgraw-Hill Publication, 1987.
4. John.J.Craig, Introduction to Robotics: Mechanics & control, Second edition-2002.
5. M.P.Groover, Industrial robotics- Technology, programming and Applications, McGraw-Hill, 1986.

7MH4: REFRIGERATION AND AIR CONDITIONING

3L+1T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1

Introduction: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle.

Vapour Compression Refrigeration System: Analysis of simple vapour compression Refrigeration cycle by ph and T-S diagram, Effect of operating conditions, liquid vapour heat exchangers, actual refrigeration cycle,

Multiple Evaporator and Compressor System: Application, air compressor system, Individual compressor, compound compression, cascade system, application, air compressor systems, individual compressor, compound compression, cascade system.

UNIT 2

Gas Cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger, Air cycle for air craft, Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.

UNIT 3

Vapour Absorption System: Simple Vapour absorption system, Electrolux Refrigerator, Analysis of Ammonia absorption refrigeration system, Lithium Bromide Absorption Refrigeration System.

Refrigerants: Classification, Nomenclature, selection of refrigerants, global warming potential of CFC Refrigerants, Refrigeration Equipments - Compressor, condenser, evaporator, expansion devices – types and working.

UNIT 4

Psychometric: Psychrometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor and air washers.

Human Comfort: Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.

UNIT 5

Cooling Load Calculations: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling, selection of air conditioning, apparatus for cooling and dehumidification, air conditioning system.

List of Recommended Books

1. Refrigeration and Air Conditioning, Stoecker W.F**.,** McGraw Hill Publication.
2. Modern Refrigeration and Air Conditioning, Andrew D. Althouse, GoodHeart-Willcox Co.
3. Refrigeration and Air Conditioning, Arora C.P., Tata McGraw Hill New Delhi.
4. Refrigeration and Air Conditioning, Jorden and Priester, Prentice Hall of India.
5. Refrigeration and Air Conditioning, Ballaney R.C., Khanna Publication.
6. Refrigeration and Air Conditioning, Jain V.K., Tata McGraw Hill New Delhi.

7MH5: FUEL CELL HYBRID ELECTRIC ENGINE

3L+1T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 2
Introduction
Basic principle of Mechanization, Automation and Automatic Controls,Open and Close Loop systems, Adaptive control,Hydraulic, Pneumatic and Electro-mechanical actuating systems. Product cycle in conventional and computerized manufacturing environment. Introduction to CAM. Advantages and disadvantages of CAM

UNIT 2
N C Systems
Numerical Control in CAM: Definition, Historical Background, basic components of NC system, Classification, NC Procedure, Coordinate system, motion control systems, Advantages of NC systems .Economic of NC. Principle of operation of CNC, Features of CNC, Development in CNC systems, Direct Numerical Control (DNC)

UNIT 3
Part Programming
Numerical control part programming: punched tape, tape coding & format. Manual part programming. Computer assisted part programming**:** Automatically programmed tools programming (APT).

UNIT 4
CIM and Group technology
Introduction to Computer integrated manufacturing Systemsand FMS, Computer aided process planning, Introduction to AGV. Introduction to GT, GT cell and flow lines, different part coding systems, Part print analysis,optiz's and multi class coding.

UNIT 5
Robot Technology
Introduction, Industrial Robots, Robot physical Configuration, Basic Robot motions, Technical features such as work volume, precision of movement speed of movement, weight carrying capacity, type of drive systems. Introduction to Robot Languages, End Erectors, work cell control and interlocks, Robotic sensors, Robot applications & economics, Intelligent robots, interfacing of a vision system with a Robot

Text Book
1 CAD/CAM, Groover , Tata MCGraw-Hill Publication.

Reference Books:
1. CAD/CAM , Ibrahim Zied, Tata McGraw-Hill Publication.
2. CAD/CAM/CIM, Radhakrishanan. New Age.Publication .

7MH6.1: STEAM TURBINES AND STEAM POWER PLANT

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1

Steam Turbines: Principle and working of steam turbines, type of turbines, impulse and reactions,
compounding for pressure and velocity, Velocity triangles for various types.

UNIT 2

Stage efficiency, diagram efficiency, steam speed to blade, speed ratio for optimum performance, Energy losses in steam turbine, turbine performance at various loads and governing of steam turbines, Constructional details and description of steam turbine components in brief.

UNIT 3

Regenerative Feed Heating Cycles: Introduction, Most Ideal Regenerative feed heating cycle, Regenerative feed heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, Other types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. Feed Heaters, Direct Contact Heaters, Surface Heaters

Reheating–Regenerative and Regenerative water Extraction Cycles: Reheating of steam, Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, regenerative water extraction cycles, practical feed heating arrangements.

UNIT 4

Governing and Performance of Steam Turbines: Description of back pressure Turbines, pass-out Turbines and Mixed Pressure Turbines.

UNIT 5

Steam Power Plant: Steam power plants selection of location, working medium, Fuels and fuel handling equipments, ash handling equipments, Air pre-heater, feed water treatment, Methods of combustion and various type of combustors, Types of boilers, Modern developments in steam boilers, Description of cooling tower.

List of Recommended Books

1. A Practical Guide to Steam Turbine, Heinz P. Bloch, McGraw Hill Publication.
2. Steam, Gas Turbine and Power Plant Engineering, Yadav R., CPH Allahabad.
3. Steam Turbines: Design Application and Rerating, Heinz P. Bloch, McGraw Hill Publication.
4. Steam Turbine: Theory and Design, Shlykhin P., University press of Pacific.
5. Steam Turbine: Theory and Construction, Wilde and Salter, Merchant Books.
6. Power Plant Engineering, ShamsherGautam, Vikas Publication.
7. Power Plant Engineering, Nag P.K., Tata McGraw-Hill, New Delhi.
8. Power Plant Engineering, Domkudwar and Arora, DhanpatRai Publication.
9. Power Plant Technology, El-Wakil, McGraw-Hill (student Edition).
10. Modern Power Plant Engineering, Joel Weisman and Roy Eckert, PHI Pvt. Ltd., New Delhi.

7MH6.2: PRODUCT LIFECYCLE MANAGEMENT

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1

Introduction to PLM and Strategies

Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning.

Industrial strategies, strategy elements, its identification, selection and implementation, change management for PLM.

UNIT 2

Product Data Management (PDM)

PDM systems and importance, reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.

UNIT 3

Product Design

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modeling and simulation in product design.

UNIT 4

New Product Development

Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

UNIT 5

Technology Forecasting

Future mapping, invocating rates of technological change, methods of technology forecasting such as relevance trees, morphological methods

and mission flow diagram, combining forecast of different technologies, uses in manufacture alternative.

Reference Books:

1. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.
2. Robert J. Thomas, NPD: Managing & forecasting for strategic processes.
3. Martins Joseph, Technological Forecasting for decision Making, 2nd edition, North Holland.

List of Open Source Software/learning website:

I. http://nptel.ac.in/courses/110101005/downloads/Lecture%2039.pdf
II. http://www.product-lifecycle-management.info/what-is-plm/PLM-ROI.html
III. http://www.iped-uk.com/Product_Life_Cycle_Management.pdf
IV. http://www.sap.com/bin/sapcom/cs_cz/downloadasset.2011-07-jul-06-07.product-lifecycle-management-bringing-sustainable-products-to-market-faster-pdf.html
V. http://www.urenio.org/tools/en/Product_Life_Cycle_Management.pdf
VI. http://www.entrepreneurial-insights.com/product-life-cycle-management-guide/
VII. http://www.tcs.com/SiteCollectionDocuments/White%20Papers/Manufacturing-Enterprise-PLM-1013-1.pdf

7MH6.3: OPERATIONS RESEARCH

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1

Linear Programming: Introduction and Scope, Problem formulation, Simplex methods, primal and dualproblem, dual Simplex, sensitivity analysis.

UNIT 2

Transportation, Transshipment and Assignment problems.

Dynamic Programming: Multistage decision problems and solution, Principle of optimality.

UNIT 3

Decision Theory: Decision under various conditions,

Game Theory: Minimum and maximum strategies, Application of linear programming.

Integer Programming: Cutting Plane method and Branch and Bound method.

UNIT 4

Deterministic and Stochastic Inventory Models: Single and multi period models with continuous and discrete demands, Service level and reorder policy.

UNIT 5

Simulations: Simulation Versus mathematical modeling, Monte Carlo simulation, simulation language ARENA, Example and cases.

Queuing Models: Introduction Model types, M/M/1 and M/M/S systems, cost consideration.

List of Recommended Books

1. Introduction to Operations Research, Hillier F.S. and Lieberman G.J., CBS Publishers.
2. Operations Research, Taha H.A., Pearson Education.
3. Operations Research, Ravindran, Phillips and Solberg, Wiley India.
4. Principles of Operations Research, Wagner H.M., Prentice Hall of India.
5. Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.
6. Operations Research, Gupta and Heera, S. Chand Publications.

7MH7: ROBOTICS LABORATORY
MM: 100

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinatesystem
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

7MH8: COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING LAB

MM: 100

LIST OF EXPERIMENTS

1. Modelling of a part using Pro-E / CATIA / UNIGRAPHICS.
2. Modelling of a component using Pro-E / CATIA / UNIGRAPHICS.
3. Modelling and assembling of the mechanical assembly using Pro-E / CATIA / UNIGRAPHICS.
4. Structural analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
5. Beam deflection analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
6. Thermal analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
7. Vibration or modal analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
8. Modelling and tool path simulation using Master CAM (MILL) or any CAM package.
9. Modelling and tool path simulation using Master CAM (Lathe) or any CAM package.
10. NC code generation for milling using Master CAM (MILL) or any CAM package.
11. NC code generation for turning using Master CAM (Lathe) or any CAM package.

NOTE - Any solid modelling or suitable software packages can be used for exercise.

SYLLABUS
Mechatronics Engineering
IV Year B.Tech. : VII Semester

8MH1: NOISE, VIBRATION AND HARSHNESS

3L+1T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1

Sound Level and Subjective Response to Sound: Frequency dependent human response to sound, Sound pressure dependent human response, Decibel scale, Decibel addition, subtraction and averaging, Relationship among sound power, sound intensity and sound pressure level, Sound spectra, Octave band analysis, Loudness.

Noise: Effects, Ratings and Regulations, Non-auditory effects of noise on people, Auditory Effects of noise, Noise standards and limits in India, Major sources of the noise, Industrial noise sources, Industrial noise controlstrategies, Noise control at the source, Noise control along the path, Acoustic barriers, Noise control at the receiver.

UNIT 2

Scope of Vibration: Important terminology and classification, Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition, Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion, Damped vibrations of single degree of freedom systems, Viscous damping, underdamped, critically damped and
overdamped systems, Logarithmic decrement, Vibration characteristics of Coulomb damped and Hysteretic damped systems.

UNIT 3

Forced Vibrations of Single Degree of Freedom Systems: Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support.

Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.

UNIT 4

System with Two Degrees of Freedom: principle mode of vibration, Mode shapes, Un-damped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Un-damped dynamic vibration absorber and centrifugal pendulum absorber

Many Degrees of Freedom Systems: exact analysis.

UNIT 5

Many Degrees of Freedom Systems: approximate methods, Rayleigh's, Dunkerley's, Stodola's and Holzer's methods, Vibrations of continuous systems, Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.

List of Recommended Books

1. Mechanical Vibrations, Rao S.S., Pearson Education.
2. Mechanical Vibrations and Noise Engineering, Ambekar A.G., Prentice Hall India.
3. Mechanical Vibrations, Grover G.K., Nem Chand and Brothers.
4. Theory of Vibrations with Applicaion, Thomson and Dahleh, Pearson Education.
5. Elements of Vibration Analysis, Leonard Meirovitch, Tata McGraw-Hill, New Delhi.
6. Principles of Vibration, Benson H.Tongue, Oxford Publcation.

8MH2: DIGITAL IMAGE PROCESSING

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
DIGITAL IMAGE FUNDAMENTALS
Introduction – Examples of fields that use Digital image processing, Fundamental steps in Digital Image Processing systems, Components of an image processing systems, Light and EM spectrum, Image sensing and acquisition, Image sampling and quantization- Concepts, image representation, Spatial and gray level resolution, Aliasing and Morie patterns, Some basic relationships between pixels.

UNIT 2
IMAGE ENHANCEMENT IN SPATIAL DOMAIN
Background, Gray level transformation- Image negatives, Log transformations, Power law transformations, Piecewise-Linear transformation functions, Histogram processing- Histogram
equalization, Histogram matching(Specifications), Enhancement using ALU

UNIT 3
IMAGE ENHANCEMENT IN FREQUENCY DOMAIN
Introduction to the Fourier transform and the frequency domain – 1-D Fourier transform and its inverse, 2-D Fourier transform and its inverse, Smoothing frequency domain filters- Ideal, Butterworth, Gaussian low pass filters, Sharpening frequency domain filters- Ideal, Butterworth, Gaussian high pass filters.

UNIT 4
COLOR IMAGE PROCESSING AND WAVELETS
Color fundamentals, Color models- RGB color model, CMY and CMYK color model, HIS color model.
Wavelets- Background- Image pyramids, sub band coding, Haar transform, Wavelet transform in 1-D- Wavelet series expansion, discrete wavelet transform, Continuous wavelet transform.

UNIT 5
IMAGE COMPRESSION AND SEGMENTATION
Fundamentals – Image compression models, Error-free compression – Lossy compression-Lossy predictive coding, Transform coding, JPEG 2000 – Detection of discontinuities – Edge linking and boundary detection

REFERENCES

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Education Asia / Addison Wesley publishing company, Sixth Indian Reprint 2001.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall of India, New Delhi, 2001.
3. Maher A. Sid-Ahmed, “Image Processing Theory, Algorithms and architectures”, McGraw Hill, 1995.
4. William K. Pratt, “Digital Image Processing”, Wiley-Inter Science Publication, 2nd Edition, 1991.
5. Arthur K Wreeks, “Fundamentals of Electronics Image Processing”, Prentice-Hall of India, New Delhi, 2001

8MH3: GAS TURBINES AND GAS POWER PLANT

3L+1T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT1

Review of Basic Principles and Fundamentals of Rotating Machines: Cycle arrangements, open cycle arrangements, closed cycle arrangements, basic requirement of the working medium, properties of various working media, applications of gas turbine, comparison of gas turbines with reciprocating engines. Ideal cycles, simple gas turbine cycle, heat exchange cycle, reheat cycle, reheat and heat exchange cycle, intercooled cycle, intercooled cycle with heat exchanger, intercooled and reheat cycle, intercooled cycle with heat exchange and reheat, Comparison of various cycles.

UNIT 2

Practical Cycles and their Analysis: Effect of variable specific heat, mechanical losses, loss due to incomplete combustion, polytropic efficiency, performance of actual cycles, comparison of ideal versus actual cycles, Jet propulsion cycles.

UNIT 3

Thermodynamic Cycles: Advantages, disadvantages and performance characteristics of Ram jet engine, pulse jet engine, turbo prop engine, turbo jet engine, turbo fan engine, Calculation of specific thrust and efficiency.

UNIT 4

Combustion Systems: Combustion theory applied to gas turbine combustor, factors affecting combustion chamber design and performance, Combustion chamber geometry, fuel injection and ignition, use of cheap fuels, Impulse and reaction type gas turbines, Velocity triangles and calculation of work done, efficiency etc.

UNIT 5

Advantages of a gas turbine power plant, comparison with steam, diesel and hydel power plant, Performance of GT power plant-part load efficiency, airflow rate, thermal efficiency, gas turbine blading and fuels, Gas turbine materials, Free piston engine plant.

List of Recommended Books

1. Power Generation Handbook, Philip Kiameh, McGraw Hill.
2. Gas Turbine Engineering Handbook, Meherwan P. Boyce, Gulf Professional Publication.
3. Power Plant Engineering, Elanchezhian C., I.K. International Publicity House.
4. Power Plant Engineering, Nag P.K., McGraw Hill Publication.
5. Fundamental of Gas Turbine, William W. Bathie, Willey Eastern Ltd.
6. Gas turbine theory, Cohen and Saravanamutto, Pearson Educational Publication.
7. Gas turbines, V. Ganesan, Tata McGraw-Hill.

8MH6.1: MARKETING MANAGEMENT

3L+0T **Max. Marks: 100** **Exam. Hrs. : 3**

UNIT 1

MARKETING PROCESS

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus
consumer marketing, consumer goods, industrial goods, product hierarchy

UNIT 2

BUYING BEHAVIOUR AND MARKET SEGMENTATION

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic -Psycho graphic and geographic segmentation, process, patterns.

UNIT 3

PRODUCT PRICING AND MARKETING RESEARCH

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT 4

MARKETING PLANNING AND STRATEGY FORMULATION

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT 5

ADVERTISING, SALES PROMOTION AND DISTRIBUTION

Characteristics, impact, goals, types, and sales promotions- point of purchase-unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trendsin retailing.

TEXT BOOKS:

1. Govindarajan. M, “Marketing management – concepts, cases, challenges and trends”, Prentice hall of India, second edition 2007.
2. Philip Kolter,KoshyJha “Marketing Management”, Pearson Education ,Indian adapted edition.2007

REFERENCES:

1. Ramasamy and Namakumari, “Marketing Environment: Planning, implementation and control the Indian context”, 1990.
2. Czinkota&Kotabe, “Marketing management”, Thomson learning, Indian edition 2007
3. Adrain palmer, “ Introduction to marketing theory and practice”, Oxford university press IE 2004.
4. Donald S. Tull and Hawkins, “Marketing Reasearch”, Prentice Hall of Inida-1997.
5. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, 2000.
6. Steven J.Skinner, “Marketing”, All India Publishers and Distributes Ltd. 1998.
7. Graeme Drummond and John Ensor, Introduction to marketing concepts, Elsevier, Indian Reprint, 2007.

8MH6.2: TOTAL QUALITY MANAGEMENT

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
INTRODUCTION
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT 2
TQM PRINCIPLES
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT 3
TQM TOOLS & TECHNIQUES I
The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT 4
TQM TOOLS & TECHNIQUES II
Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT 5
QUALITY SYSTEMS
Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing-QS 9000-ISO 14000- Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TEXT BOOK
1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia,Third Edition, Indian Reprint (2006).

REFERENCES
1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

8MH6.3: PROJECT ENGINEERING

3L+0T **Max. Marks : 100** **Exam. Hrs. : 3**

UNIT 1
FEASIBILITY ANALYSIS
Project Feasibility analysis: Marketing, Technical and financial feasibility, case studies, report preparation.

UNIT 2
PROJECT PLANNING
Project management: nature, scope, PERT, CPM techniques, principles, applications.

UNIT 3
TIME VALUE OF MONEY
Internal and time value of money: simple interest, compound interest, present worth uniform series payments, use of interest tables, nominal and effective interest rates, continuous compounding, uniform continuous payment, uniform gradient.

UNIT 4
EVALUATION OF ALTERNATIVES
Methods of tangible evaluation of alternatives: Equivalent annual worth comparisons, present worth comparisons rate of return comparisons.
Methods of forecasting: Need for forecast – statistical method, time series analysis, method of least squares, moving average method, curvilinear trend, correlation analysis

UNIT 5
REPLACEMENT AND RISK ANALYSIS
Replacement policy: item deteriorating with time and items that fail completely (not accounting for time value of money), accounting time value of money, replacement policy for new and old machine with infinite horizon.
Risk analysis: Risk in economic analysis, measuring risk investment, risk profiles, decision trees, formulation of discounted tree.

REFERENCES
1. Prasanna Chandra, “Projects”, Tata McGraw Hill, 2003
2. Patel Bhavesh . M, Project Management, Strategic Financial Planning Evaluation and Control, Vikas Publishing House, New Delhi, 2000
3. James, L. Riggs, “Engineering Economics”, Tata McGraw Hill, 1998.
4. Willium G. Sullivan, James A. Bontadelli, Elin M Wicks, Engineering Economy Pearson Education Asia, 2001.
5. Pannirselvam. R, Engineering Economics, PHI, 2006s

8MH4: MECHANICAL VIBRATIONS LAB

MM: 100

LIST OF EXPERIMENTS

1. To verify relation T = 2 / (l/g) for a simple pendulum.
2. To determine radius of gyration of compound pendulum.
3. To determine the radius of gyration of given bar by using bifilar suspension.
4. To determine natural frequency of a spring mass system.
5. Equivalent spring mass system.
6. To determine natural frequency of free torsional vibrations of single rotor system.
   i. Horizontal rotor
   ii. Vertical rotor
7. To verify the Dunkerley's rule.
8. Study of free damped torsional vibration to performing the experiment to find out damping co-efficient.
9. To conduct experiment of trifler suspension.
10. Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11. Study of Vibration measuring instruments.

8MH5: INDUSTRIAL ENGINEERING LAB

MM: 75

1. Determination of time standard for a given job using stopwatch time-study.
2. Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3. Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4. To carry out a work sampling study.
5. To conduct process capability study for a machine in the workshop.
6. To design a sampling scheme based on OC curve.
7. To conduct Shewart's experiments on known population
8. Generation of random numbers for system simulation such as facility planning, job shop scheduling etc.

8MH6: HEAT TRANSFER LAB

MM: 75

Experiments to be Performed (Minimum 10 Numbers)

1. To Determine Thermal Conductivity of Insulating Powders.
2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3. To Measure the thermal Conductivity of Liquid.
4. To determine the transfer Rate and Temperature Distribution for a Pin Fin.
5. To Measure the Emissivity of the Test plate Surface.
6. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
7. To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8. Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
9. To Determine Critical Heat Flux in Saturated Pool Boiling.
10. To Study Performance of Simple Heat Pipes.
11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
12. To Find the Heat transfer Coefficient in Forced Convection in a tube.
13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.
14. To find out the thermal conductivity of given slab material.
15. To determine the individual thermal conductivity of different lagging in a lagged pipe.
16. To study the rates of heat transfer for different materials and geometries
17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
18. Testing and performance of different heat insulators.