DR. A P J ABDUL KALAM UNIVERSITY,

INDORE

SYLLABUS

of

BACHELOR OF ENGINEERING

Mechanical Engineering

(Third year (VII SEMESTER), Grading System)

DR. A P J ABDUL KALAM UNIVERSITY, INDORE

Syllabus for Bachelor of Engineering

Mechanical Engineering

List of Subject (Fourth Year (VII SEMESTER), Grading System)

Sub Code : ME-701T(A) Sub Name : Elective–I (Design Of Heat Exchanger) Credit: 4

UNIT -I: Introduction: Types of heat exchangers heat transfer laws applied to heat exchangers convection Coefficients, resistance caused by the walls and by fouling, overall heat transfer coefficient.

Unit -II: Thermal & hydraulic design of commonly used heat exchangers :
LMTD & NTU Methods, correction factors Double pipe heat exchangers , shell and tube heat exchangers, condensers , Evaporators ,Cooling and dehumidifying coils ,cooling towers, evaporative condensers ,design of air washers, desert coolers.

Unit- III: TEMA standard: Tubular heat exchangers TEMA standard heat-exchanger - nomenclature, selection criteria for different types of shells and front and rear head ends; geometrical characteristics of TEMA heat exchangers.

Unit -IV: Review of mechanical Design, Materials of Construction, corrosion damage, testing and inspection.

Unit -V: Heat Pipe: Basics & its mathematical model, micro Heat Exchangers0, Use of Software in heat exchanger design.

References:
1. Kern D Q, Kraus A D; Extended Surface Heat Transfer; TMH.
2. Kays, Compact Heat Exchangers and London, TMH.
3. Kokac, Heat Exchangers-Thermal Hydraulic fundamentals and design;TMH.
4. Tubular Exchanger Manufacturer Association (TEMA), and other codes

Unit – I : Method study: purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

Unit-II : Work measurement: Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed; rating and methods of rating, allowances, calculation of standard time.
Work sampling: Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.

Unit –III: Job evaluation and incentive schemes: Starlight line, Tailor, Merrick and Gantt incentive plans
Standard data system; elemental and non-elemental predetermined motion systems, work factors system; Methods Time Measurement (MTM), MOST

Unit –IV : Human factor engineering: Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing: Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

Unit –V : Display systems and anthropometric data: Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactual display, characteristics and selection.

Reference:
1. ILO; work-study; International Labour Organization
2. Khan MI; Industrial Ergonomics; PHI Learning
3. Barrnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contenmprory ergonomics; Taylor & fracis
5. Sandera M and Mc Cormick E; Human Factors in Engg and design; MGHill
6. Currie RM; Work study; BIM publications
7. Mynard; Hand book of Industrial Engg;

Unit – I : Method study: purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

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7. Mynard; Hand book of Industrial Engg;

UNIT-I Solar Radiation: Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. **Solar thermal conversion**: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration.
Solar photovoltaic: Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems; Organic PV cells.

UNIT-II Wind energy characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Waybill, Rayleigh and Normal distribution, Measurement of wind data,
Energy estimation of wind regimes; **Wind Energy Conversion**: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics; power curve of wind turbine, capacity factor, matching wind turbine with wind regimes; Application of wind energy.

UNIT-III Production of biomass, photosynthesis-C3 & C4 plants on biomass production; Biomass resources assessment; Co2 fixation potential of biomass; Classification of biomass; Physicochemical characteristics of biomass as fuel **Biomass conversion** routes: biochemical, chemical and thermo chemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types, power generation from gasification, cost benefit analysis of power generation by gasification.

UNIT-IV Small Hydropower Systems: Overview of micro, mini and small hydro system; hydrology; Elements of turbine; Assessment of hydro power; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. **Ocean Energy:** Ocean energy resources, ocean energy routs; Principle of ocean thermal energy conversion system, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.

UNIT-IV Geothermal energy: Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; **Hydrogen Energy**: Hydrogen as a source of energy, Hydrogen production and storage. **Fuel Cells**: Types of fuel cell, fuel cell system and sub-system, Principle of working, basic thermodynamics

References:
1. Kothari, Singal & Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, Narosa Publ
5. Koteswara Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.

Unit I: Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems. Undammed Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newtons second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Unit II: Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Unit III: Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments). Whirling Motion and Critical Speed : Whirling motion and Critical speed : Definitions and significance .Critical speed of a vertical , light flexible shaft with single rotor : with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit IV: Systems With Two Degrees of Freedom : Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit V: Noise Engineering Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipments; hearing conservation and damage risk criteria, daily noise doze. Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipments and domestic appliances, industrial noise control, strategies-noise control at source (with or without sound enclosures), noise control along the path (with or without partitions and acoustic barriers); noise control at the receiver, ear defenders, earplugs, semi-insert protectors.

References:-

1- Ambekar A.G., Mechanical Vibrations and Noise Engineering; PHI

2- Meirovitch Leonard; Element of Vibration Analysis; TMH

3- Dukikipati RV Srinivas J Text book of Mechanical Vibrations; PHI

4- Kelly SG and kudari SK; Mechanical Vibrations; Schaum Series;TMH

5- Thomson , W.T., Theory of Vibration with Applications , C.B.S Pub & distributors .

6- Singiresu Rao, Mechanical Vibrations , Pearson Education .

7- G.K. Grover, Mechanical Vibration , Nem chand and Bross , Roorkee .

Unit :-I Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables only, special cases of transportation and assignment and its solution, Vogel's forward looking penalty method, cell evaluation degeneracy, use of SW Linda, Tore, Excel.

Unit:-II Supply chain (SCM): Definition, importance, expenditure and opportunities in SCM; integration of inbound, outbound logistics and manufacturing to SCM, flow of material money and information, difficulties in SCM due to local v/s system wide (global) optimization and uncertainties in demand and transportation; Bull-whip effect; customer value; IT, info-sharing and strategic partnerships; plant and warehouse-network configuration; supply contracts and revenue sharing; outsourcing; transportation, cross docking and distribution, forecasting models in SCM; coordination and leadership issues; change of purchasing role and vendor rating, variability from multiple suppliers.

Unit:-III Inventory models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time (=WIP/ Throughput), JIT/ lean mfg; basic EOQ/ EPQ models for constant review Q-system(S,s); periodic review, base stock P-system; service level, lead time variance and safety stock;; ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Unit:-IV (a) Waiting Line Models Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1) average length and times by Little's formula, optimum service rate; basic multiple server models (M/M/s) (b) Competitive strategy: concept and terminology, assumptions, pure and mixed strategies, zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Unit:-V(a) Decision analysis: decision under certainty, risk probability and uncertainty; Hurwitz criteria; AHP- assigning weight and consistency test of AHP (b) Meta-heuristics Definition of heuristic and meta-heuristic algorithms; introduction to Taboo search, Simulated Annealing and Genetic algorithms and solution of traveling salesman and non linear optimization problems.

References:-

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH

2. Simchi-Levi, Keminsky; Designing and managing the supply chain; TMH.

3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning

4. Mohanty RP and Deshmukh SG; Supply Chain Management; Wiley India

5. Taha H; Operations research; PHI

6. Sen RP; Operations Research-Algorithms and Applications; PHI Learning

7. Sharma JK; Operations Research; Macmillan

8. Ravindran , Philips and Solberg; Operations research; Wiley India

9. Vollman, Berry et al; Manufacturing planning and control for SCM; TMH.

10. Bowersox DJ, Closs DJ, Cooper MB; Supply Chain Logisti Mgt; TMH

11. Burt DN, Dobler DW, StarlingSL; World Class SCM; TMH

12. Bronson R ;Theory and problems of OR; Schaum Series; TMH

Unit-I: Chassis & Body Engg: Types, Technical details of commercial vehicles, types of chassis, lay out, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, drivers cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Unit-II: Steering System: front axle beam, stub axle, front wheel assembly, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Unit-III: Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller & spring clutch, clutch lining and bonding, double declutching, types of gear Boxes, synchronizer, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction.

Unit-IV: Suspension system : Basic suspension movements, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energisation, air bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres & tubes.

Unit-V: Electrical and Control Systems: storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, Lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers. importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems.

Unit-VI: Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References:-

1. Crouse , Automotive Mechanics TMH.

2. Srinivasan S; Automotive engines; TMH

3. Gupta HN; Internal Combustion Engines; PHI;

4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.

5. Kripal Singh, Automotive Engineering Khanna Pub.

6. Newton & Steeds ,

Sub Code : HU 224P	Sub Name : Yoga	0 Credits

Objective: To develop physical fitness and mental peace among students

UNIT I
YOG & PRANAYAM::Introduction, benefits of pranayam, Asan

UNIT II
Meditation – Agnai, Asanas, Kiriyas, Bandas, Muthras, benefits of Agnai Meditation

UNIT III
Benefits of santhi Meditation Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras Meditation Santhi

UNIT IV
Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras Benefits of Thuriyam

UNIT V
Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Importance of Arutkappy & muhurtas Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras

UNIT VI NATIONAL SPORTS ORGANISATION (NSO)
Each student must select two of the following games and practice for two hours per week. An attendance of 80% is compulsory to earn the credits specified in the curriculum. List of games:

- Basket Ball
- Football
- Volley Ball
- Badminton
- Cricket
- Throw ball

References

1. Prāṇāyāma Rahasya Book by Ramdev
2. Sampoorn Yog Vidhya by Rajiv Jain Trilok
3. Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority by B.K.S. Iyengar

List of experiments (please expand it); Mechanical Vibration and Noise Engineering-AU/ ME 703

1- To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .

2- To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.

3- To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil ;

4- To observe the phenomenon of whirl in a horizontal light shaft and to determine the critical speed of the shaft.

5- To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.

6- To demonstrate the principle of tuned Undammed Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies ;

7- To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.

List of experiments (please expand it):

1. Use computer and software to solve problems contained in the syllabus

2. Case studies in SCM

List of experiments (please expand it):

1. Study of chassis,
2. suspension,
3. steering mechanisms,
4. transmission,
5. gear-box,
6. differential systems, and
7. electrical systems of various light and heavy automotive vehicles;

Provision of Minor project is made as preparation phase-I for major project or to take it as an independent small project. For details of project see ME-806- Major project

Objective :-

Objective of Industrial Training The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved. The student should take this course as a window to the real World and should try to learn as much as possible from real life experiences by involving and interacting with industry staff. Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester. Scheme of Studies: Duration: Minimum 4 weeks in summer break after VI semester, assessment to be done in VII semester Scheme of Examination: For the assessment of industrial training undertaken by the students,