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T.E. (Mechanical S/W) (Semester – II) Examination, 2009
MECHATRONICS
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **3** questions from Section **I** and **3** questions from Section **II**.*
*2) Answers to the two Sections should be written in **separate books**.*
*3) **Neat** diagrams must be drawn **wherever** necessary.*
*4) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*5) Assume suitable data, **if necessary**.*

SECTION – I

1. a) Define Mechatronics. Explain the basic block diagram of Mechatronic System. **8**
   b) Sketch the characteristics of any four flow and pressure measuring devices. **8**

OR

2. a) Explain the following :
      i) Accuracy and Precision
      ii) Hysteresis
      iii) Resolution
      iv) Threshold. **8**
   b) Explain the construction and working of Rotameter. State its few disadvantages. **8**
3. a) What is level measurement ? Explain any two level measuring transducers in detail. **8**
   b) A strain gage with a G.F. of 4 has a resistance of 120 Ω when unstrained. If the strain gage undergoes a change in length from 0.25 mm to 0.255 mm. Find the new resistance. **8**

OR

4. a) What is pyrometer ? Explain the construction and working of any one pyrometer in detail. **8**
   b) Explain with a neat sketch incremental and absolute optical encoders. **8**

5. a) Develop a mathematical model for fluid, thermal and electromechanical systems. **9**
   b) State the advantages and disadvantages of various control systems. **9**

OR

P.T.O.

6. a) Write short notes on the following :
   i) Feedback and feedforward control system.
   ii) Transfer function. **9**

   b) Explain the building blocks of mechanical and electrical systems. **9**

SECTION – II

7. a) ExplainProportional + Integral + Derivative control actions. **6**

   b) Write a short note on flow and temperature switches. **6**

   c) Explain dynamic response of second order system to a ramp and a step input. **6**

OR

8. a) Write a short note on relays. **6**

   b) Explain the stability of control system. **6**

   c) Explain Bode plot with suitable example. **6**

9. a) Write a short note on :
   i) Application of Flip-Flop.
   ii) Decade counter. **6**

   b) Write a short note on D/A convertor. **5**

   c) Explain operational amplifier as a Differentiator and Integrator. **5**

OR

10. a) Write a short note on Schmitt trigger. **5**

    b) Explain inverting and non inverting operational amplifier. **6**

    c) Explain JK Flip-Flop. **5**

11. a) Explain the use of counters and internal relays in PLC. **6**

    b) Write a short note on microcontroller. **5**

    c) Explain the criteria considered for selection of PLC's. **5**

OR

12. a) Explain the PLC with a block diagram. **6**

    b) Explain any one application of Mechatronic system using PLC. **10**

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T.E. (Mech. – S/W) (Semester – II) Examination, 2009
THEORY OF MACHINES AND MACHINE DESIGN– II
(2003 Course)

Time: 4 Hours Total Marks: 100

Instructions : *1) Answers to the **two** Sections should be written in **separate** books.*
*2) **Neat** diagrams must be drawn **wherever** necessary.*
*3) **Black** figures to the right indicate **full** marks.*
*4) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*5) Assume suitable data, if **necessary**.*

SECTION –I
UNIT – I

1. a) Explain the following :
   i) Precision points for function generation
   ii) Angle relationship for function generation **8**

   b) What is Chebychev spacing ? Determine the Chebychev spacing for the function $y = x^{0.8}$ for the range $1 \leq x \leq 3$ where three precision points are required to be considered. **8**

OR

2. The following data relate to a Cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent.

Minimum radius of cam	=	25 mm
Roller radius	=	7.5 mm
Lift	=	28 mm
Offset of follower axis	=	12 mm towards right
Angle of ascent	=	60°
Angle of descent	=	90°
Angle of dwell between ascent and descent	=	45°
Speed of the cam	=	200 rpm

Draw the profile of the cam and determine the maximum velocity and the uniform acceleration of the follower during the outstroke and the return stroke. **16**

P.T.O.

UNIT – II

3. a) Two right-handed helical gears connect two shafts 70°apart. The larger gear has 50 teeth and the smaller 20. If the centre distance is 180 mm, determine the helix angle of the gear. The normal module is 4 mm. **6**

   b) Two gears 30 and 40 involute teeth respectively are in mesh. Pressure angle = 20°, module pitch = 12 mm. The line of contact on each side of the pitch point is half the maximum possible length. Find the height of addendum for each gear wheel. **6**

   c) Explain interference and how is it avoided. **4**

OR

4. a) In a spiral gear drive, the spiral angle of the teeth on the driving wheel has been fixed at 50°. The normal pitch of the teeth is 12.5mm. The driving wheel A turns at twice the driven wheel B, the shafts are at right angles and the shortest distance between them is approximately 17.5 cm. Determine the dimensions of suitable gears for the drive, giving for each wheel a) the number of teeth b) the spiral angle of teeth c) the circular pitch and d) the pitch diameter. **8**

   b) Write a short note on :
      i) Reverted Gear train
      ii) Epicyclic Gear train **8**

UNIT – III

5. a) What is friction clutch ? Explain the multi-plate clutch with neat sketch. **6**

   b) A car engine has its rated output of 120 kW. The maximum torque developed is 110 N-m. The clutch used is of single type having two active surfaces. Axial pressure is not to exceed 0.85 bar. External diameter of the friction plate is 1.25 times the internal diameter. Determine the dimensions of the friction plate and the axial force exerted by the spring. Assume uniform wear and coefficient of friction to be 0.3. **12**

OR

6. a) Describe with neat sketch the construction and working of Epicyclic train type dynamometer. **6**

   b) Derive an equation for the maximum and minimum tensions in the brake straps for band and block brake. **8**

   c) Differentiate between brakes and dynamometers. **4**

SECTION – II
UNIT – IV

7. a) Derive a relationship for wear strength of a helical gear pair. **4**

b) It is required to design a spur gear reducer for a pump running at 720 rpm. It is driven by a 3 kW, 1440 rpm electric motor. The centre to center distance between the axes of the gear shafts should be exactly 180 mm. The gears are made of plain carbon steel 50 c4 and the permissible bending stress can be assumed to be 100 MPa. Design the gears and suggest suitable hardness. Assume the total error in the gears as 10 microns and deformation factor as 11400× error (in N/mm). Assume service factor and factor of safety as 1.

Take $y = 0.484 - \frac{2.87}{z}$ where z = No. of teeth. $K = 0.16\left(\frac{BHN}{100}\right)^2$

Assume face width b = 10×module.

Dynamic load $Fd = \frac{21V(bc + F_{T\max})}{21V + \sqrt{bc + F_{T\max}}}$

First preference values of module in mm, 1, 1.25, 1.5, 2, 3, 4, 5, 6, 8, 10, 12, 16 and 20

Velocity Factor $C_v = \frac{3}{3+v}$ **12**

OR

8. a) Derive stress equation for Helical Springs. **8**

b) A semi-elliptic leaf spring used for automoblie suspension consists of three extra full length leaves and 15 graduated length leaves, including the master leaf. The center to center distance between two eyes of the springs is 1m. The maximum force that can act on spring is 75 kN. For each leaf the ratio of thickness to width is 1:9. The modulus of elasticity of the leaf material is 207000 N/mm^2. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are 450 N/mm^2. Determine,

i) the width and thickness of the leaves.

ii) the initial nip and

iii) the initial pre load required to close the gap c between extra-length leaves and graduated length leaves. **8**

UNIT – V

9. a) Explain the stresses induced in flywheel. **6**

b) Explain the desirable properties of clutch facing materials. Give the commonly used materials. **4**

c) The following data is given for rimmed flywheel made of grey cast iron;
Mean Radius of the rim = 1m
Thickness of the rim = 100 mm
Width of the rim = 200 mm
Number of spokes = 4
Cross sectional area of each spoke = 6500 mm^2
Speed of rotation =720 rpm
Mass density of fly wheel = 7200 kg/m^3.
Calculate :
i) the maximum tensile stress in the rim and
ii) The axial stress in each spoke. **6**
Take ϕ=45°

OR

10 a) Show that for a plate clutch having fixed outer radius of friction surface r_o and inner radius r_i, the torque transmitted capacity is maximum when ratio r_o/r_i is equal to 1.733. **6**

b) The turning moment diagram of a multicylinder engine is drawn with a scale of (1 mm = 6°) on the abscissa and (1 mm = 650 Nm) on the ordinate. The intercepted areas between the torque developed by the engine and the mean resisting torque of the machine taken in order from one end are –30, +382, –260, +310, –306, +248, – 380, +265 and – 229 mm^2. The engine is running at a mean speed of 900 rpm and the total fluctuation of speed is not to exceed $\pm$1.8%. A rimmed flywheel made of grey cast iron FG 200 (ρ=7100 kg/m^3) is provided. The spokes, hub and shaft are assumed to contribute10% of the required moment of inertia. The rim has rectangular cross section and the ratio of width to thickness ratio is 1.5.
Determine the dimensions of the rim. **10**

UNIT – VI

11. a) Derive an expression for load carrying capacity of the hydrostatic step bearing. State the assumptions made. **12**

b) It is required to select a ball bearing suitable for a 50 mm diameter shaft rotating at 1500 rpm. The radial and thrust loads at the bearing are 5000N and 1800N respectively. The values of X and Y factors are 0.56 and 1.2 respectively. Select a proper ball bearing from the following table for the rating life of 22500 hr.

Bearing No.	6010	6210	6310	6410
C(N)	21600	35100	61800	87100

6

OR

12. a) Describe the parameters used in selecting the type of a rolling contact bearing. **6**

b) Sketch 'back to back' and 'face to face' arrangements of two taper roller bearings to mount a stepped shaft. **4**

c) What are the performance variables for hydrodynamic bearings ? Discuss the variation of any two significant variables against bearing characteristic number. **8**

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T.E. (Mechanical/S/W) (Sem. – II) Examination, 2009
THERMAL ENGINEERING – II
(2003 Course)

Time: 3 Hours Total Marks: 100

Instructions *:1) Answer* ***three*** *questions from Section –* ***I*** *and* ***three*** *questions from Section –* ***II****.*

2) Answers to the ***two*** *Sections should be written in* ***separate*** *books.*

3) ***Neat*** *diagrams must be drawn* ***wherever*** *necessary.*

4) ***Black*** *figures to the* ***right*** *indicate* ***full*** *marks.*

5) ***Use*** *of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is* ***allowed****.*

6) ***Assume*** *suitable data,* ***if necessary****.*

SECTION – I

1. a) In vapour compression refrigeration cycle what is subcooling and superheating ? Explain with the help of diagram its effect on C.O.P. **4**

   b) What are the advantages of vapour absorption refrigeration system over vapour compression refrigeration system ? **4**

   c) A food storage locker requires refrigeration capacity of 12 TR and works between evaporating temperature of -8°C and condensing temperature of 30°C. The refrigerant R–12 is subcooled by 5°C before entry to expansion valve and vapour is superheated to – 2°C before leaving evaporator coils. Determine :

   i) Coefficient of performance ii)Theoretical power per tonne of refrigeration.

   Use the following data for R-12 :

Sat. Temperature (0^0C)	Pressure (bar)	Enthalpy (kJ/Kg)		Entropy (kJ/kgK)	
		Liquid	Vapour	Liquid	Vapour
-8	2.354	28.72	184.07	0.1149	0.7007
30	7.451	64.59	199.62	0.2400	0.6853

For R_{12} C_{pl} = 1.235 kJ/kgK and C_{pv} = 0.733 kJ/kgK. **8**

OR

2. a) Explain CFC and non-CFC refrigerants. **4**

   b) How organic refrigerants are designated ? Give example. **4**

   c) A Bell Coleman refrigerator works between 4 bar and 1 bar pressure limits. After compression, cooling water reduces air temperature to 17°C. What is the lowest temperature produced by the ideal machine ? Compare COP of this machine with that of ideal carnot cycle machine working between same pressure limits, the temperature at the beginning of compression being – 13°C. **8**

3. a) Explain comfort chart. **6**

   b) Show the following processes on skeleton psychrometric chart.

      i) Adiabatic mixing of two streams.

      ii) Sensible heating

      iii) Cooling and dehumidification. **4**

   c) Atmospheric air at 30°C dry bulb temperature and 45% R.N. is to be conditioned to 17°C dry bulb temperature and and 15°C wet bulb temprature. Find the amount of heat rejected by air. Also find sensible heat factor of the process. **6**

OR

4. a) Give classification of air conditioning system. **4**

   b) Explain the air conditioning system which is required in summer season. **4**

   c) A sling psychrometer reads 44°C dry bulb temperature and 30°C wet bulb temperature. Calculate :

      i) Vapour pressure ii) Specific humidity

      iii) Relative humidity iv) Dew point temperature.

      v) Enthalpy of mixture per kg of dry air. **8**

5. a) Prove that the intercooler pressure (P_2) for minimum work required, for a two stage reciprocating air compressor is given by $P_2 = \sqrt{P_1 P_3}$. **6**

   b) What are different methods to improve isothermal efficiency of reciprocating compressor. **4**

   c) A single stage reciprocating air compressor is required to compress 1kg of air from 1 bar to 4 bar. The initial temperature is 27°C. Compare the work requirement in following cases :
      i) Isothermal compression.
      ii) Compression with $PV^{1.2}$ = constant.
      iii) Isentropic compression. **8**

OR

6. a) Explain static and total head quantities. **4**

   b) Derive an expression for efficiency of Roots blower in terms of pressure ratio and ratio of specific heats. **6**

   c) An axial flow compressor, with compression ratio as 5, draws air at 20°C delivers it at 50°C. Assuming 50% degree of reaction, find velocity of flow if the blade velocity is 100 m/sec. Also find number of stages. Take work factor as 0.85, α=10°, β=40° and C_p = 1 kJ/kg K. **8**

SECTION – II

7. a) "Spark ignition engine cannot burn very lean fuel air ratio mixture but Compression ignition can" – Discuss the statement with reference to process of combustion in these engines. **8**

   b) Explain with the help of neat sketch on Open Chamber and Divided Combustion Chamber. Which one gives higher thermal efficiency ? **8**

OR

8. a) Explain Pre-ignition in SI engines. Does it cause detonation in these engine ? **8**

   b) Discuss the process of combustion in CI engines clearly bringing out the importance of delay period. **8**

9. a) Explain the thermodynamic cycle on PV diagram for supercharged compression ignition IC engine with mechanical coupled supercharger. **8**

   b) What are catalytic converters ? How does it help reduse emission from engines ? **8**

OR

10. a) Discuss the supercharging of compression ignition IC engines by exhaust gas turbo supercharger. Under what conditions, this type is recommended ? **8**

    b) What is meant by total emission control packages ? Describe with sketches the two types of total emission control packages. **8**

11. a) i) Prove that the thermal efficiency of gas turbine is given by $\eta_{th} = 1 - \frac{1}{r_p\left(\frac{\gamma-1}{\gamma}\right)}$ with usual notation.

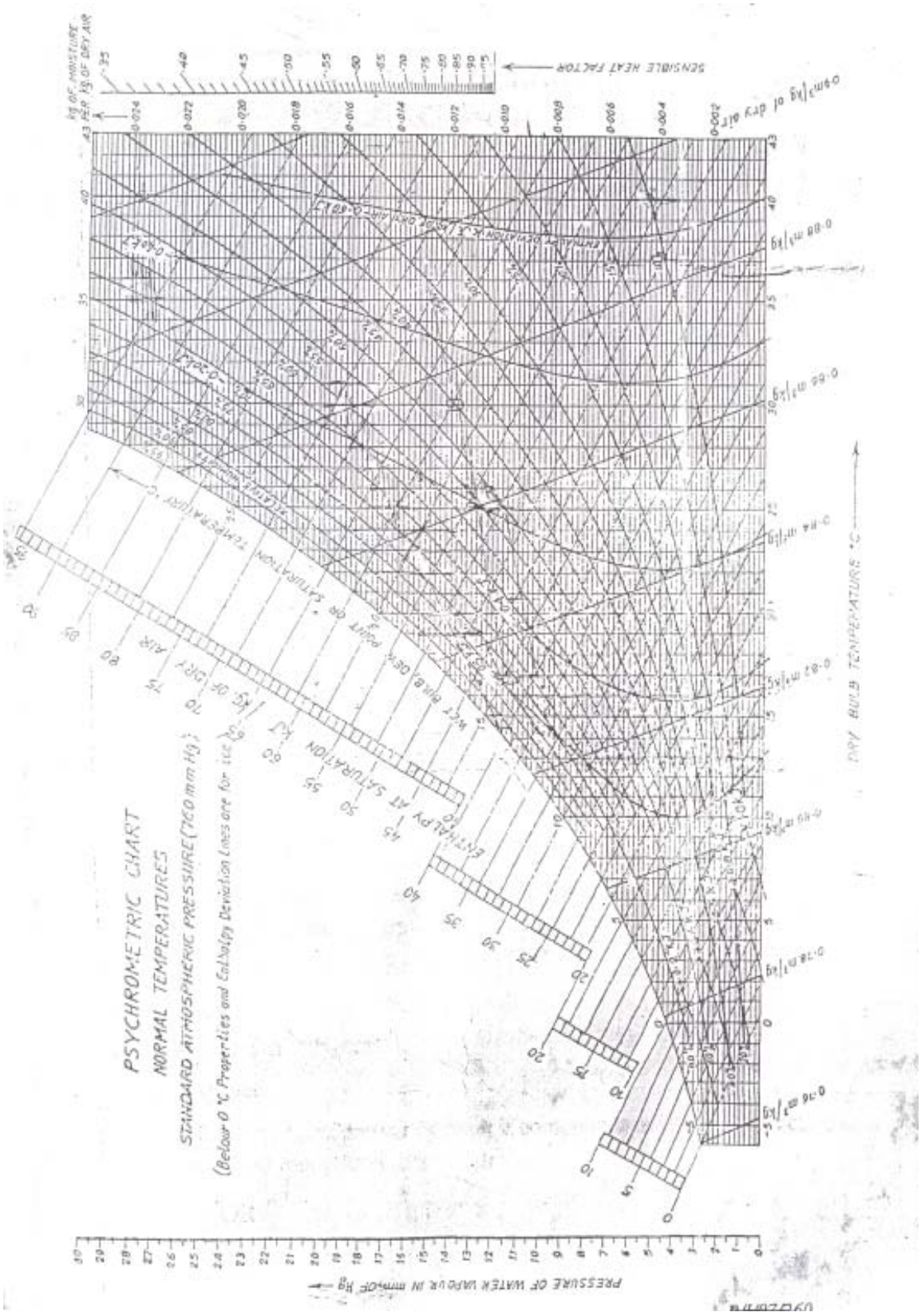
    ii) How are gas turbine classified ? State merits of closed cycle gas turbine over open cycle gas turbine. **4**

    b) Differentiate between Rocket propulsion and Jet propulsion. **6**

OR

12. a) A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610°C. The isentropic efficiencies of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kW of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/s. Take C_p=1.005 kJ/kg°K and γ = 1.4 for compression process and take C_p = 1.11 kJ/kg°K and γ= 1.333 for the expansion process. Also calculate thermal efficiency and work ratio of plant if C_p = 1.11 kJ/kg°K for combustion process. **12**

    b) Describe with neat sketch the working of Ramjet. Also state its merits and demerits. **6**


PSYCHROMETRIC CHART
NORMAL TEMPERATURES
STANDARD ATMOSPHERIC PRESSURE (760 mm Hg)
(Below 0 °C Properties and Enthalpy Deviation Lines are for ice)
SENSIBLE HEAT FACTOR
DRY BULB TEMPERATURE °C
PRESSURE OF WATER VAPOUR IN mm OF Hg

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T.E. (Mechanical) S/W (Semester – I) Examination, 2009
Elective – I : BEHAVIOURAL SCIENCE
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any 3** questions from **each** Section.*
*2) Answer **3** questions from Section **I** and **3** questions from Section **II**.*
*3) Black figures to the **right** indicate **full** marks.*

SECTION – I

1. a) Define the purpose of an Industrial Enterprise. Discuss in detail factors influencing the governing of enterprise. **8**

   b) Explain with diagram, line organisation, and line and staff organisation. Mention their advantages and disadvantages. **8**

2. a) Explain the formation and working of Partnership organisation and joint stock company stating their merits and demerits. **8**

   b) State various theories of organisation. **8**

3. What is motivation ? Explain the following :
   1) Theory X and theory Y.
   2) Herzberg two factor theory of work motivation.
   3) Mc Clellands Achievement Theory. **16**

4. Write short note on (**any three**) : **18**
   i) Public Vs. Private sector.
   ii) Formal and Informal organisation
   iii) Industrial lincensing
   iv) Explain cognitive learning theory.

P.T.O.

SECTION – II

5. a) What do you understand by group and group dynamics ? **8**

   b) Explain the different leadership styles with the help of managerial grid. **8**

6. a) Explain the barriers to communication. **8**

   b) Define interview. How will you conduct and conclude an interview ? **8**

7. What is conflict management ? Discuss various types of conflicts, its nature and causes and resolution of conflicts. Give examples. **16**

8. Write short note on (**any three**) : **18**

   a) Transactional Analysis

   b) Grapevine

   c) Leadership qualities

   d) Path goal model of leadership.

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T.E. (Mech.) Sandwich (Semester – I) Examination, 2009
MANUFACTURING MANAGEMENT
(Elective – I) (2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions *: 1) Answers to the **two** Sections should be written in **separate** books.*
*2) **Neat** diagrams must be drawn **wherever** necessary.*
*3) Black figures to the **right** indicate **full** marks.*
*4) Use of electronic pocket calculator is **allowed**.*
*5) Assume suitable data, if **necessary**.*
*6) **All** questions are **compulsory**.*

SECTION – I

1. a) Explain in brief inputs required for production process with suitable illustration. **8**

   b) Explain wastes in conversion process. **6**

   c) Explain systems approach applied to a production function. **4**

OR

2. a) Enumerate salient characteristics of batch production and job production. **10**

   b) Explain in brief various functions of PPC. **8**

3. a) List and explain the sources of product improvement. Illustrate with a suitable example. **8**

   b) Enumerate considerations given in good product design (any 8). **8**

OR

4. a) Explain economics of large scale production. **8**

   b) Explain principles of plant layout. **8**

P.T.O.

5. a) Explain the concept of scheduling along with the factors affecting it. **8**

   b) What is line balancing ? Explain its technique. **8**

OR

6. a) Write short notes (**any four**) : **16**
   i) JIT.
   ii) Batch size decision.
   iii) SMED.
   iv) Make-buy decision.
   v) Group technology.

SECTION – II

7. a) Describe the following :
   1) Exponential smoothing method of forecasting.
   2) Time series analysis. **8**

   b) A manufacturer has to supply his customers 3600 units of his product per year. Shortages are not permitted. Inventory carrying cost amounts Rs. 1.2 per unit per annum. The set up cost per run is Rs. 80. Find
   1) Economic order quantity.
   2) Optimum number of orders per annum.
   3) Average annual inventory cost (minimum).
   4) Optimum period of supply per optimum order. **8**

OR

8. a) What is M.R.P. ? Explain M.R.P. procedure in detail. State advantages and disadvantages of M.R.P. **8**

   b) State the objectives of
   1) short term forecasting.
   2) long term forecasting. **8**

9. a) Describe the following with reference to project management :
   1) Critical Path Method (CPM).
   2) Crushing and optimum duration in project. **8**

   b) What are inventories ? Why does it essential to keep inventories ? Explain. **8**

OR

10. a) Describe PERT. How concept of float, resource levelling will be considered during PERT. Explain with suitable example. **8**

    b) Explain how data and information, feed back system, links between different functions in management information system. **8**

11. Describe following with reference to Management Information System : **18**
    1) E.R.P.
    2) S.A.P.
    3) Supply chain management.

OR

12. Write short note on the following (**any three**) : **18**
    1) Bill of material.
    2) ABC Analysis.
    3) Accuracy of forecast.
    4) Advantages of forecasting.
    5) Computer Applications in MIS.

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T.E. (Mech.) (Semester – I) Examination, 2009
REFRIGERATION AND AIR-CONDITIONING
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any three** questions from **each** Section.*
*2) Answer **three** questions from Section **I** and **three** questions from Section **II**.*
*3) Answers to the **two** Sections should be written in **separate** books.*
*4) **Neat** diagrams must be drawn **wherever** necessary.*
*5) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*6) **Assume** suitable data, **if necessary**.*

SECTION – I

Unit – I

1. a) Explain Steam-Jet refrigeration system with neat sketch. **6**

   b) A regenerative air refrigeration system is designed to take 30TR of an aircraft cabin with a flight speed of 1500 km/hr. The ambient conditions are 0.1 bar and – 63°C. The ram efficiency is 90%. The pressure ratio of the main compressor is 5 with internal efficiency 0.9. The air bled off the main compressor is cooled by ram air in a heat exchanger which is 60% effective. The air from the heat exchanger passes through cooling air turbine whose internal efficiency is 0.8. Some portion of air from the cooling turbine is led to the regenerative heat exchanger reducing the temperature refrigerating air to 30° C. The cooling air gets heated to 92°C before discharging to atmosphere. The cabin pressure is 0.8 bar and maintained at 25°C. Determine;

   i) The percentage of air extracted for regenerative cooling

   ii) Power required to maintain the cabin at required condition

   iii) COP

   Assume cooling turbine power to be used for ram air exhaust fan. **10**

OR

2. a) Explain Reduced ambient system with help of schematic and T-S diagram. **8**

   b) An air refrigeration system working on bell-coleman cycle is used to make ice at –5°C from water at 15°C. The suction and compression pressures are 1 atm and 5 atm. Find i) Lowest temperature produced in the system ii) COP iii) Ice produced per k Wh. **8**

P.T.O.

Unit – II

3. a) How refrigerants are classified ? **4**

   b) State desirable properties of refrigerants commonly used in refrigerating plants. **4**

   c) An R-134 a refrigeration system produces 10 TR at evaporating temperature -10°C and the condensing temperature of 40° C. The absolute pressure measured at the inlet and outlet of evaporator are 2 bar and 1.7 bar respectively. Considering there are no superheat and sub cooling effects, calculate the following parameters with or without drop of pressure in the evaporator :

   i) Refrigerant effect
   ii) Mass flow rate
   iii) Power requirement in kW/TR
   iv) COP. **8**

OR

4. a) Explain the different processes of actual vapour compression cycle with the help of p-h diagram. **8**

   b) A vapour compression refrigerator works between the pressures of 4.98 bar and 1.86 bar. The temperature of vapour leaving the compressor is 25° C. The liquid is Cooled to 9°C before throttling. The vapour is 95% dry before compression. Using the data below, find the C.O.P. of the refrigerator.

   The specific heat at constant pressure for superheated vapour is 0.65 kJ/kgK and for liquid 0.97 kJ/kgK. **8**

Pressure (bar)	*Temp. °C*	*hf (kJ/kg)*	*hfg (kJ/kg)*
4.98	14.45	49.22	148.3
1.86	-15	21.74	162

Unit – III

5. a) What is necessity of multi evaporator system ? Explain the analysis of three evaporators at different temperatures with individual compressors and multiple expansion valves. **8**

   b) A compound ammonia compression system of 175 TR has two compressors, one evaporator, one flash intercooler and a liquid-to vapour heat exchanger. The enthalpy values at various stages are as follows :

   i) Subcooled liquid ammonia leaving HE and entering flash intercooler through float valve = 320kJ/kg
   ii) Saturated liquid ammonia leaving flash intercooler and entering expansion valve = 197 kJ/kg
   iii) Dry saturated ammonia vapour leaving evaporated and entering HE = 1416 kJ/kg
   iv) Superheated ammonia vapour leaving HE and entering LP compressor = 1433 kJ/kg

v) Superheated ammonia vapour leaving LP compressor and entering flash intercooler = 1593 kJ/kg

vi) Superheated ammonia vapour leaving flash intercooler and entering HP compressor = 1517 kJ/kg

vii) Superheated ammonia vapour leaving HP compressor and entering condenser = 1676 kJ/kg.

Calculate :

a) The quantity of refrigerant handled by LP and HP compressors

b) The power of the two compressors

c) The COP. **10**

OR

6. a) Compare vapour absorption system with vapour compression system. **4**

b) Explain construction and working of lithium bromide vapour absorption system. **8**

c) Explain what you understand by half, single and double effect absorption systems. **6**

SECTION – II

Unit – IV

7. a) Define efficiency of heating and cooling coil.

b) Prove that relative humidity (Ø) is given by **4**

$$\phi = \frac{\mu}{1-(1-\mu)\left(\frac{p_v}{p_b}\right)}$$

Where, μ = Degree of Saturation, p_v = Partial pressure of water vapour, p_b = Barometric pressure. **6**

c) A sample of air has DBT and WBT 35°C and 25°C respectively. The barometric pressure is 760 mm of Hg. Calculate without using psychrometric chart :

1) Humidity Ratio, Relative Humidity and enthalpy of the sample.

2) Humidity Ratio, Relative Humidity and enthalpy, if the air were adiabatically saturated.

Only the use of steam table is permitted. **6**

OR

8. a) Illustrate with a neat sketch the working of an air washer. Explain how various Psychrometric processes can be achieved by controlling the temperature of spray water. **6**

b) Sketch comfort chart and show comforts zone on it. **2**

c) It is required to design an air-conditioning plant for an office for following winter conditions :

Outdoor conditions : 12° C DBT and 9° C WBT
Required conditions : 20° C DBT and 55% RH
Amount of air circulation : 0.30 m^3 / min / person
Seating capacity of office : 50

The required condition is achieved first by heating and then by adiabatic humidification. Determine the following :

1) Heating capacity of the coil in kW and the surface temperature required if the bypass factor of coil is 0.4.
2) The capacity of the humidifier. **8**

Unit – V

9. a) What is infiltration load ? Explain method of estimation of infiltration load. **4**
   b) Describe different controls used in air-conditioning plant briefly. **6**
   c) Describe central air-conditioning system. What are the advantages and disadvantages of this system over split air conditioning ? **6**

OR

10. a) Explain the working of an automatic expansion valve. Why it is called constant pressure expansion valve ? **6**
    b) Discuss the frosting and defrosting evaporators. **4**
    c) Given for the air-conditioning of a room :

Room conditions : 26.5° C DBT, 50% RH
Room sensible heat gain : 26. 3kW
Room sensible heat factor : 0.82

Find the following :

1) The room latent heat gain
2) The apparatus dew point temperature
3) The Cmm of air if it is supplied to the room at the apparatus dew point temperature. **6**

Unit – VI

11. a) What are the requirements of good room air-distribution. **6**
    b) What are the objectives of duct designing ? Explain static regain method of duct design giving its advantages and disadvantages. **6**
    c) A 20 m long rectangular duct, 200 mm x 160 mm in size, carries air at the rate of 24 m^3/min. Assuming the friction factor, f = 0.0048, determine :
       1) Total pressure required at the inlet to the duct to maintain this flow
       2) Air power required. **6**

OR

12. a) What is the need to preserve food and vegetables ? Explain factors responsible for the spoilage of the food and vegetables. **7**
    b) What are the different types of insulating materials used in air-conditioning ? What factors are considered in selecting the insulating materials ? **6**
    c) Write a short note on cold storage. **5**

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T.E. (Mechanical) (Sem. – II) Examination, 2009
FLUID MACHINERY
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any three** questions from **each** Section.*
*2) Answers to the **two** Sections should be written in **separate** books.*
*3) **Neat** diagrams must be drawn wherever **necessary.***
*4) Black **figures** to the **right** indicate **full** marks.*
*5) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed.***
*6) **Assume** suitable data, **if necessary**.*

SECTION – I

Unit – I

1. A) Explain the different efficiencies of a water turbine. **8**

   B) Prove that the force exerted by a jet of water on a fixed semi circular plate in the direction of the jet when the jet strikes at the centre of the semi circular plate is two times the force exerted by the jet on fixed vertical plate. **8**

OR

2. A) What do you understand by hydrodynamic machine ? Give the classification of hydrodynamic machine. **8**

   B) A jet of water 40 mm diameter strikes a hinged square plate at its centre with a velocity of 25 m/sec. The plate is deflected through an angle of 30°. Find the weight of plate. If the plate is not allowed to swing, what will be the force required at the lowered edge of the plate to keep the plate in vertical position. **8**

Unit – II

3. A) Draw a neat sketch of Pelton wheel bucket. Show all principle dimensions in terms of jet diameter. **4**

   B) A single jet Pelton wheel has a penstock 0.8 m in diameter and 6 km long. The gross head is 350 m above the centre of nozzle. The friction factor for the pipe is 0.032. The jet has a diameter of 0.12 m. The co-efficient of velocity for nozzle is 0.97. The velocity of bucket is 0.47 of the jet speed; the outlet vane angle for the bucket is 15°. The relative velocity of water is reduced by 12% in passing over the buckets. The mechanical efficiency is 90%. Draw velocity triangle and find water power, power developed by turbine, hydraulic efficiency and overall efficiency. **12**

OR

4. A) Obtain an expression for the work done per second by water on the runner of a Pelton wheel. Hence derive an expression for maximum efficiency of the Pelton wheel giving the relationship between jet speed and bucket speed. Draw inlet and outlet velocity triangles for the Pelton turbine and indicae the direction of various velocities. **10**

   B) A Pelton wheel works under a net head of 600 m and it runs at a speed of 700 rpm. The mean diameter of runner is 1.35 m. For a discharge rate of 0.22 m^3/s, find the power available at the nozzle and hydraulic efficiency of turbine. Assume no frictional losses in nozzle and over the buckets and outlet clearance angle is 15°. **6**

Unit– III

5. A) What is a draft tube ? Define efficiency of draft tube. Derive an equation for the same. **8**

   B) An inward flow reaction turbine operates under a head of 14 m with a speed of 310 rpm. The inner and outer diameters of the runner are 510 mm and 765 mm respectively. The width of the runner at inlet is 75 mm. The blade thickness occupies 16% of the runner passage. The velocity of flow is constant throughout and flow ratio is 0.22. Water leaves the runner radially. The blade efficiency is 92%, while the overall efficiency is 85%. Calculate : **10**

   i) Guide vane angle at inlet
   ii) Moving vane angle at inlet and outlet
   iii) Flow rate through turbine
   iv) Power developed
   v) Breadth of the runner at outlet.

OR

6. A) Explain the statement “When the draft tube is provided in reaction turbine, the net head remains the same even when the turbine is installed above the tail race.” **8**

   B) A Kaplan turbine runner has outer diameter of 4.5 m and the diameter of the hub is 2 m. It is required to develop 20.6 MW when running at 150 rpm, under a head of 21 m. Assuming hydraulic efficiency of 94% and overall efficiency of 88%, determine the runner vane angle at inlet and exit at the mean diameter of the vane. **10**

SECTION – II

Unit – IV

7. a) A hydraulic turbine is to develop 845.6 kW when running at 100 r.p.m. under a head of 10 m. Work out the maximum flow rate and specific speed for the turbine if the overall efficiency at the best operating point is 92%. In order to predict its performance, a 1 : 10 scale model is tested under a head of 6 m. What would be the speed, power output and water consumption of the model if it runs under the conditions similar to the prototype ? **8**

b) Write short notes on **(any two)** : **8**

i) Surge Tanks

ii) Selection of Hydraulic Turbines

iii) Governing of Reaction Turbines.

OR

8. a) Write short notes on **(any two)** : **8**

i) Scale Effect.

ii) Model Testing and Model Laws.

iii) Similarity applied to Turbines and Pumps.

b) A centrifugal pump (single stage) runs at 500 r.p.m. and delivers 300 m^3/min of water against a head of 120 m. The pump impeller is 2 m in diameter and it has a positive suction lift (including the velocity head and friction) of 3 m. Laboratory tests are to be conducted on a model with 450 mm diameter impeller and on a reduced head of 95 m. Assuming atmospheric head = 10.15 m of water and vapour head = 0.34 m of water calculate the speed, discharge and suction lift for the laboratory tests. **8**

Unit – V

9. a) Write short notes on **(any two)** : **8**

i) Deferent types of Casings used in Centrifugal Pumps.

ii) Multi-staging in Centrifugal Pumps.

iii) Characteristics curves of Centrifugal Pumps.

b) A centrifugal pump impeller whose external and internal diameters are 400 mm and 200 mm respectively is running at 950 r.pm. The rate of flow through the pump is 0.035 m^3/s. The suction and delivery heads are 5 m and 30 m respectively. The diameters of the suction and delivery pipes are 120 mm and 80 mm respectively. If the outlet vane angle is 45°, the flow velocity is constant and equal to 1.8 m/s and power required to drive the pump is 15 kW, determine :

i) Inlet vane angle

ii) The overall efficiency

iii) The manometric efficiency. **10**

OR

10. a) Define the specific speed of the centrifugal pump. Derive the formula for finding out specific speed of the centrifugal pump. **5**

b) Explain Cavitation in Centrifugal Pumps. **4**

c) A centrifugal pump impeller whose external diameter and width at the outlet are 0.8 and 0.1 m respectively is running at 550 r.p.m. The angle of impeller vanes at outlet is 40°. The pump delivers 0.98 m^3 of water per second under an effective head of 35 m. If the pump is driven by a 500 kW motor, determine : **9**

i) The manometric efficiency

ii) The overall efficiency

iii) The mechanical efficiency.

Unit – VI

11. a) Explain the difference between Fluid Coupling and Hydraulic Torque Converter. Explain any one of them with sketch and Construction and Working. **10**

b) Explain with neat sketch, construction and working of Air Lift Pump. **6**

OR

12. a) Explain construction and working of Hydraulic Ram with schematic diagram. Explain various efficiencies applicable to Hydraulic Ram. **8**

b) Write short notes on **(any two)** : **8**

i) Deep Well Pump.

ii) Submersible Pumps.

iii) Regenerative Pump.

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T.E. (Mechanical) (Semester – II) Examination, 2009
TRANSMISSION SYSTEM DESIGN
(2003 Course)

Time : 4 Hours Max. Marks : 100

Instructions : *1) Answers to the **two** Sections should be written in **separate** books.*
*2) **Neat** diagrams must be drawn **wherever** necessary.*
*3) Black figures to the **right** indicate **full** marks.*
*4) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*5) Assume suitable data, if **necessary**.*

SECTION – I

Unit – I

1. a) What is the objective of bearing preloading ? **3**

   b) Explain the mounting and preloading of a taper roller bearing with appropriate sketch. **4**

   c) A ball bearing carries a radial load of 400 N at 1760 rpm for 40% time, 600 N at 880 rpm for 30% time, 200 N at 1000 rpm for 10% time and no load at 1500 rpm for remaining period of the cycle.

   If the expected life of the bearing is 10,000 hours with 95% reliability, calculate

   i) Basic dynamic load capacity of the bearing.

   ii) Average speed of bearing operation. **10**

OR

2. a) Derive Stribeck's equation for static capacity of a rolling contact bearing. **7**

   b) A transmission shaft is supported by two deep groove ball bearings at two ends. The centre distance between the bearings is 160 mm. A load of 300 N acts vertically downwards at 60 mm distance from the left hand bearing whereas a load of 550 N acts horizontally at 50 mm distance from the right hand bearing.

   Shaft speed is 3000 rpm and expected life of the bearings is 7000 hours with a reliability of 95%. It is intended to use same bearing at both ends of the shaft. Calculate dynamic load rating of the bearing so that it can be selected from manufacturer's catalogue. **10**

P.T.O.

Unit – II

3. a) Following data is given for a caliper disk brake with annular pad, for the front wheel of the motor cycle :

   Torque capacity = 1500 Nm Coefficient of friction = 0.35

   Outer radius of pad = 150 mm Number of pads = 2

   Inner radius of pad = 100 mm

   Average pressure intensity = 2 MPa

   Calculate the angular dimension of pad. **8**

   b) Compare suitability of caliper disk brake with a shoe brake. **4**

   c) State the properties of friction materials that play an important role in selection. Discuss the selection of friction material for wet and dry clutches. **6**

OR

4. a) A centrifugal clutch transmitting 10 kW at 750 rpm consists of four shoes. The clutch is to be engaged at 500 rpm. The inner radius of the drum is 165 mm while the radius to the centre of gravity of the shoes in engaged position is 140 mm. The coefficient of friction is 0.3. Calculate the mass of each shoe. **4**

   b) Discuss the heat dissipation in clutches and brakes. **4**

   c) A cone clutch with asbestos lining is used to transmit 30 kW power at 1440 rpm. The coefficient of friction between the contacting surfaces is 0.2 while the permissible intensity of pressure is 0.35 N/mm^2. The semi cone angle is 12.5°.

   The mean radius of the friction surface is twice the face width. Assuming uniform pressure condition. Find

   i) Dimensions of friction lining.

   ii) Axial force required to engage the clutch. **10**

Unit – III

5. a) Explain the reasons for speed variations in chain drives. **3**

   b) Explain the stresses is wire rope. **3**

c) A fan is driven by an open belt drive from a 30 kW, 1000 rpm electric motor. Fan pulley diameter is 900 mm while the motor shaft pulley diameter is 250 mm. Centre distance between the shafts is 2.25 m. Coefficient of friction between the belt and the pulley is 0.25 and allowable tensile stress in the belt is limited to 2 MPa. Density of belt material is 950 kg/m^3 and belt width is 100 mm.

Calculate :

i) Belt thickness

ii) Belt length and

iii) Initial tension. **10**

OR

6. a) Derive the condition for maximum power transmitting capacity of the belt. **4**

b) Compare belt, chain and gear drives with respect to the power transmitting capacity, performance, losses and noise and areas of application. Give two applications of each drive. **8**

c) Write a note on 'silent chains'. **4**

SECTION – II

Unit – IV

7. a) What is dynamic load on gears ? State the factors on which the dynamic load depends and explain the methods of estimation of dynamic load on gear tooth. **5**

b) A pair of spur gears with 20° full-depth involute teeth consists of a 20 teeth pinion meshing with 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for the pinion as well as for the gear is steel with an ultimate tensile strength of 600 N/mm^2. The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume the velocity factor accounts for the dynamic load and the factor of safety is 1.5.
Determine the rated power that the gears can transmit.

Use following data :

- Lewis form factor – $Y = 0.484 - \frac{2.87}{Z}$.
- Velocity factor $C_v = \frac{3}{3+V}$.
- Load stress factor = $0.16\left(\frac{BHN}{100}\right)^2 N/mm^2$. **12**

OR

8. A spur gear pair is to be used to transmit 20 kW power from an electric motor running at 1440 rpm to the machine tool expected to run exactly at 600 rpm. The pinion and gear are to be made of alloy steel 40 Ni2 Crl M_{028} (σ_{ut} = 800 N/mm^2) and plain carbon steel 55C8 (σ_{ut} = 700 N/mm^2) respectively. The service factor and factor of safety are 1.5 and 1.35 respectively. The face width is 12 times the module for which load distribution factor is 1.4. The tooth system is 20° full depth involute. The gears are to be machined to meet the specification of grade-7. The pinion and gear are to be case hardened to 400 BHN and 350 BHN respectively. Design the gear pair by using velocity factor and Buckingham's equation for dynamic load.

   Use following data :

   - Lewis form factor $Y = 0.484 - \frac{2.87}{Z}$
   - Velocity factor $C_v = \frac{6}{6+V}$
   - Load-stress factor $K = 0.16\left(\frac{BHN}{100}\right)^2 N/mm^2$
   - For grade-7- $e = 11.00 + 0.9\left(m + 0.25\sqrt{D}\right)$
   - Buckingham's equation $F_d = \frac{21v\,(bc + F_t)}{21v + \sqrt{bc + F_t}}$
   - First preference module (mm) – 1.0, 1.25, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10, 12, 16 and 20. **17**

Unit – V

9. A pair of straight bevel gears mounted on shafts that are intersecting at right angles, consists of a 24 teeth pinion meshing with a 32 teeth gear. The pinion shaft is connected to an electric motor developing 12.5 kW rated power at 1440 rpm. The starting torque of the motor is 150% of the rated torque. The pressure angle is 20°. Both gears are made of case hardened steel (σ_{ut} = 750 N/mm^2). The teeth on gears are generated and finished by grinding and lapping processes to meet the requirements of class-3 grade. The factor of safety in preliminary stages of gear design is 2.

   i) In the initial stages of gear design, assume that velocity factor accounts for the dynamic load and that the pitch line velocity is 7.5 m/s. Estimate the module based on beam strength. Select the first preference value of module and calculate the main dimensions of the gears.

   ii) Determine the dynamic load using Buckingham's equation and find out the effective load for above dimensions. What is the correct factor of safety for bending ?

   iii) Specify the surface hardness for the gears assuming a factor of safety of 2.

   Use following data :

   - Lewis form factor – $Y = 0.484 - \frac{2.87}{Z'}$
   - Load stress factor – K = 0.16 (BHN/100)^2 N/mm^2
   - Velocity factor – $C_v = \frac{5.6}{5.6 + \sqrt{V}}$
   - Determination factor C = 11400 × e N/mm
   - Buckingham's equation $F_d = \frac{21V\,(c.b + F_t)}{21V + \sqrt{(c.b + F_t)}}$
   - Maximum expected error between two meshing teeth (mm)

Module (mm)	upto 4	5	6	7	8
Class – 3 (e – mm)	0.0125	0.0125	0.0150	0.0170	0.0190

17

OR

10. a) Derive an expression for beam strength of straight bevel gear tooth. **7**

b) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20°, while the helix angle is 25°. The face width is 40 mm and normal module is 4 mm. The pinion as well as the gear is made of steel 40C8 (σ_{ut} = 600 N/mm^2) and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively. Assume that the velocity factor accounts for the dynamic load and calculate the power transmitting capacity of gears.

Use following data :

- Lewis form factor $Y' = 0.484 - \frac{2.87}{Z'}$
- Velocity factor $C_v = \frac{5.6}{5.6 + \sqrt{V}}$
- Load stress factor – $K = 0.16\left(\frac{BHN}{100}\right)^2 N/mm^2$. **10**

Unit – VI

11. a) A double start worm made of case hardened alloy steel 16 Ni 80 Cr 60(σ_{ut} = 700 N/mm^2) is to mesh with worm gear to be made of phosphor bronze (σ_{ut} = 240 N/mm^2). The gear pair is required to transmit 5 kW power from an electric motor running at 1500 rpm to a machining running at 75 rpm. The service factor is 1.25, while the factor of safety required is 2.0. The face width of the worm gear is 0.73 times the pitch circle diameter of worm. The worm gear factor is 0.685 N/mm^2, while the diametrial quotient is 10. The normal pressure angle is 14.5°. If the coefficient of friction between worm and worm gear teeth is 0.03, design the gear pair and find the power lost. Would you recommend a fan for the gear box ? Assume the permissible temperature rise is 50° C.

Use following data :

- Lewis form factor – $Y = 0.39 - \frac{2.15}{Z_g}$
- Velocity factor – $C_v = \frac{6}{6 + V_g}$
- Area of housing – $A = 1.14 \times 10^{-4} \times (a)^{1.7}$ m^2
  where a = centre distance. **11**

b) Derive an expression for efficiency of worm gear pair. **5**

OR

12. a) A pair of worm and worm wheel is designated as 3/60/10/6.
  The worm is transmitting 5 kW power at 1440 rpm to the worm wheel. The coefficient of friction is 0.1 and the normal pressure angle is 20°. Determine the components of gear tooth force acting on the worm and worm wheel. **8**

b) Derive an expressions for effective face width of the worm wheel and length of the root of the worm wheel teeth. **8**

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T.E. (Mech.) (Semester – I) Examination, 2009
COMPUTER ORIENTED NUMERICAL METHOD
(2003 Course)
(Common with Mech. S/W. for Semester – II)

Time : 3 Hours Max. Marks : 100

Instructions *: 1) Answer* ***three*** *questions from Section –* ***I*** *and* ***three*** *questions from Section –* ***II****.*
2) Answer to the ***two*** *Sections should be written in* ***separate*** *books.*
3) ***Neat*** *diagrams must be drawn* ***wherever*** *necessary.*
4) ***Black*** *figures to the* ***right*** *indicate* ***full*** *marks.*
5) ***Use*** *of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is* ***allowed****.*
6) ***Assume*** *suitable data, if* ***necessary****.*

SECTION – I

1. a) A company is manufacturing two different types of products A and B. Each product has to be processed on two machines M1 and M2. Product A requires 2 hours on machine M1 and 1 hour on machine M2, product B requires 1 hour on machine M1 and 2 hours on machine M2. The available capacity of machine M1 is 104 hours and that of Machine M2 is 76 hours profit per unit for product A is Rs. 6 and that for product B is Rs. 11.

   i) Formulate the problem.

   ii) Find the optimal solution by simplex method. **10**

   b) If $u = 3v^7-6v$, find percentage error in u at v = 1, if the error in v is 0.05. **8**

OR

2. a) Maximize $Z = 3x_1+2x_2$
   Subjected to, $2x_1+x_2 \leq 40$,
   $2x_1+3x_2 \leq 60$, and
   $x_1+x_2 \leq 24$
   $x_1, x_2 \geq 0$. **10**

   b) Explain : 1) Errors prorogation,
   2) Significant digits, and
   3) Relative errors. **8**

P.T.O.

3. a) The values of Nusselt numbers (Nu) and Reynolds numbers (Re) found experimentally are given below. If the relation between Nu and Re is of type $Nu = a.Re^b$, find the values of a and b for the given values of Nu and Re **8**

Re	3000	4000	5000	6000	7000
Nu	14.3575	16.6517	16.7353	17.6762	18.5128

b) Write a programme and draw a flowchart to fit the relation, $Nu=a.Re^b$. Assume 'N' number of values of Nu and Re. **8**

OR

4. a) The following data are taken from the steam table. Find the pressure at temperature, t = 142° C. Use suitable method of Interpolation. **8**

Temp, °C	140	150	160	170	180
Pressure Kgf/cm²	3.685	4.854	6.302	8.076	10.225

b) Draw a flowchart and write a programme for Lagrange's interpolation method. **8**

5. a) Solve the following linear simultaneous equations using Gauss Seidal method.

$20x_1 + x_2 - 2x_3 = 17$
$3x_1 + 20x_2 - x_3 = -18$
$2x_1 - 3x_2 + 20x_3 = 25$ **8**

b) From following data obtain the value of dy/dx and d^2y/dx^2 at x=1 **8**

x	1	3	5	7
y	2	6	14	24

OR

6. a) Solve the following system of equations by LU-Decomposition method. **8**

$2x_1 + 2x_2 + 3x_3 = 4$
$4x_1 - 2x_2 + x_3 = 9$
$x_1 + 5x_2 + 4x_3 = 3$

b) Draw a flowchart for Gauss Jordon method. **8**

SECTION – II

7. a) Find the root of equation $x^3 - \cos^2(x) = 0$, using Newton Raphson method, upto accuracy 0.02. Explain Convergence Criteria for this method. **8**

   b) Write a flow chart and programme for Secant method. **8**

OR

8. a) The velocity 'V' (km /hr) of a vehicle which starts from rest, is given at fixed intervals of time 't' (min) as follows :

t (min)	2	4	6	8	10	12	14	16	18	20
V (km/hr)	10	18	25	29	32	20	11	05	02	00

   Estimate approximately the distance covered in 20 minutes. **8**

   b) Write a programme for Gauss Legendre – 3 point method. **8**

9. a) Temperature at one surface of slab of thickness, x = 20 cm is T = 500°C. Find the temperature of other surface of slab by taking step size in thickness, $\Delta x = 4$ cm. Heat flux is 1000 W/m^2. Use following governing relation of heat flow,

$$\frac{dT}{dx} = -\frac{q}{A}\left[\frac{1}{0.5(0.01T+1)}\right]$$

   Where q is a heat flow through slab (in watt) and A is cross sectional area of slab (in m^2). **8**

   b) Draw a flowchart and write a programme for R.K. – Fourth order method. **8**

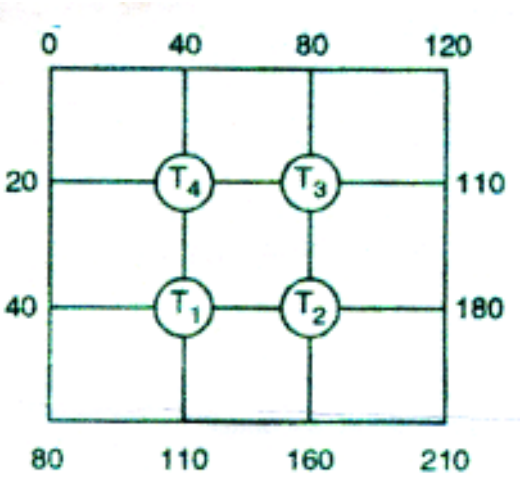
OR

10. a) Given $\frac{dy}{dx} + y + xy^2 = 0$ boundary condition, y (0) = 1

Find v (0.3) when step size, h = 0.1 using RK – second order method. **8**

b) Draw a flowchart and write a programme for modified Eulers method. **8**

11. a) Solve Laplace equation (2D heat Flow) w.r.t. the grid as shown in fig. Compute temperatures T_1, T_2, T_3 and T_4. **10**



b) Draw a flowchart for Laplace equation. **8**

OR

12. a) Solve for $du/dt = d^2u/dx^2$ the following explicit finite scheme, given by,

i) $u = \sin(\pi x)$ for $t = 0$ where $0 \leq x \leq 1$,

ii) $u = 0$ for $x = 0$ and $x = 1$ for $t = 0$ to 0.06, and

iii) Increment in t is k = 0.02 and in x is h = 0.2

Calculate values of u for t = 0 to 0.06 at x = 0 to 1. **10**

b) Draw a flowchart for wave equation. **8**

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T.E. (Mech.) (Semester – I) Examination, 2009
THEORY OF MACHINES AND MECHANISMS – II
(2003 Course)

Time : 3 Hours Max. Marks : 100

Instructions *:1) Answer* ***3*** *questions from Section* ***I*** *and* ***3*** *questions from Section* ***II****.*
2) Answers to the ***two*** *Sections should be written in* ***separate*** *books.*
3) Neat diagrams must be drawn ***wherever*** *necessary.*
4) Black figures to the ***right*** *indicate* ***full*** *marks.*
5) Assume suitable data, if ***necessary****.*

SECTION – I

1. a) A square threaded bolt has a root diameter of 27.5 mm and pitch of 5 mm. It is tightened by screwing in a nut which has a mean diameter of bearing surface of 58 mm. Determine the force required at the end of spanner, which is 60 cm long when the load on the bolt is 10 kN.

   Assume 'μ' for nut bolt = 0.1

   and 'μ' for nut and bearing = 0.15. **8**

   b) Explain the following terms
      i) virtual coeff. of friction
      ii) Angle of repose
      iii) Angle of friction. **3**

   c) Explain the friction circle in journal bearing (with sketch.) **5**

OR

2. a) An impregnated belt 10 mm × 250 mm drives a pulley 100 cm in diameter at 340 rpm. The angle of contact on the smaller pulley is 120°. The stress in the right side is 1000 kN/m^2. Determine the kW capacity of the belt. Density of the belt is 0.98 g/cm^3. The coeff. of friction between belt and pulley is .35. **10**

   b) Explain the terms slip, creep and crowning of pulley as referred to belt drive. **6**

P.T.O.

3. a) Derive an expression for frictional torque of a truncated conical pivot bearing assuming uniform wear. How will the expression can be modified for conical pivot bearing. **10**

   b) 100 kW is transmitted at 3000 rpm by multiple disc friction clutch. The plates run in oil and have the friction surfaces of steel and phosphor bronze alternately. $\mu = 0.07$ and the axial intensity of pressure is not to exceed 1.5 bar. External radius is 1.25 times the internal radius, and external radius is 12.5 cm . Determine the number of plates needed to transmit the required torque (Assume uniform wear). **8**

OR

4. a) Explain with neat sketch working of the internal expanding shoe brake also give its applications. **6**

   b) List the various types of brakes and dynamometers. **2**

   c) Derive an expression for tension ratio in case of bond and block brake with the help of necessary sketch. **8**

   d) Explain self locking or self emerging of brake. **2**

5. a) A cam operating a mushroom ended follower has the following dimension, base circle radius = 16. 5 mm, lift of the follower 7.25 mm, radius of nose = 1.6 mm. If the total period of opening and closing of the valve corresponds to 110° of cam rotation determine the radius of the flank and the maximum velocity, acceleration and retardation of the follower. Cam shaft speed is 900 rpm. **8**

   b) Write short note on kinematic equivalent of cam follower system. **4**

   c) Differentiate between cam jump and cam jerk. **4**

OR

6. a) Following data relate to a cam operating an oscillating roller follower

   i) Minimum radius of cam = 30 mm
   ii) Radius of roller = 10 mm
   iii) Length of follower arm = 45 mm
   iv) Distance of fulcrum centre from cam centre = 55 cm
   v) Angle of ascent = 80°
   vi) Angle of descent = 100°
   vii) Angle of dwell between ascent and descent = 50°
   viii) Angle of oscillation of follower = 30°

   Draw the profile of the cam if the follower moves outwards with SHM and returns with uniform acceleration and retardation. **12**

   b) What is meant by pressure angle of cam ? Upon what factors does it depend ? **4**

SECTION – II

7. a) The turning moment diagram for a multicylinder engine has been drawn to a scale of 1 mm to 600 N.m and 1 mm to 6° crank displacement. The interrupted areas between the output torque curve mean resistance line taken in order from one end in sq.mm are – 30, + 410, –280, +320, –330, + 250, – 360, + 280, – 260 sq. mm, when the engine is running at 1000 rpm.

the engine has a stroke of 300 mm and fluctuation of speed is not to exceed 2 percent of mean speed. Determine the maximum fluctuation of energy and mass of flywheel. The material density is 7200 kg/m^3 and limiting value of safe centrifugual stress is 7 MPa. Also construct the T-θ diagram. **10**

b) Explain the Flywheel for punching press and derive expression for maximum fluctuation of energy for flywheel used in punching press. **6**

OR

8. a) Brief about the function of governor. Classify the governor and with neat sketch. Explain the various terms used in governor. **6**

b) Each arm of porter governor is 200 mm long and is hinged at a distance of 40 mm from the axis of rotation. The mass of each ball is 1.5 kg and of the sleeve is 25 kg. When the links are at 30° to the vertical the sleeve begins to rise at 260 rpm. Assuming that friction force is contant, find the maximum and minimum speed of rotation when the inclination of arms to vertical is 45°. **10**

9. a) Explain the undercutting and interference in involute gear. Derive the expression for minimum number of teeth to avoid the interference, when the pinion gear with wheel. If G = 1 and pressure angle is 20°, calculate the minimum no. of teeth to avoid the interference. **8**

b) Two mating gears have 20 and 40 teeth of module 10 mm and 20° pressure angle. the addendum on each side of wheel is made such that a length of line of contact (POC) on each side of pitch point is half the maximum possible length. Determine the addendum for each gear, length of path of contact, arc of contact and contact ratio. **10**

OR

10. a) Explain the various terminology with respect to helical gear. Derive the expression for V.R. and centre distance for helical gear. **8**

b) Two 20° involute spur gear mesh externally and give a velocity ratio of 03. module is 4 mm and the addendum is equal to 1 times module. If pinion rotates at 150 rpm determine the no. of pairs of teeth in contact to avoid the interference. **10**

11. a) Derive from the first principle the equation for efficiency of worm and worm wheel, hence find the expression for maximum efficiency. **6**

b) A spiral wheel reduction gear of ratio 3 to 2, is to be used on a machine with the angle between the shaft 80°. The approximate centre distance between the shaft is 125 mm. The normal pitch of the teeth is 10 mm and wheel diameter are equal. Find the number of teeth on each wheel, pitch circle diameter and spiral angles. Find the efficiency of the drive if friction angle is 5°. **8**

c) Mention one practical application of helical gear, bevel gear, spiral gear and worm and worm wheel. **2**

OR

12. a) Define the following terms related to bevel gears
   i) pitch cone angle
   ii) Base cone angle
   iii) Shaft angle
   iv) Face width with neat sketch. **6**

b) An epicyclic gear train is shown in fig. 1. Wheel D is held stationary by the shaft A. and arm B rotates at 200 rpm. The wheel E (20 teeth) and F (40 teeth) are fixed together and rotates freely on a pin carried by the arm. The G (30 teeth) is mounted on shaft C. Find the speed of the shaft C, stating the direction of rotation relative to that of B. If the gearing transmits 7.5 kW. What will be the holding torque on shaft A. Neglect all frictional losses. **10**

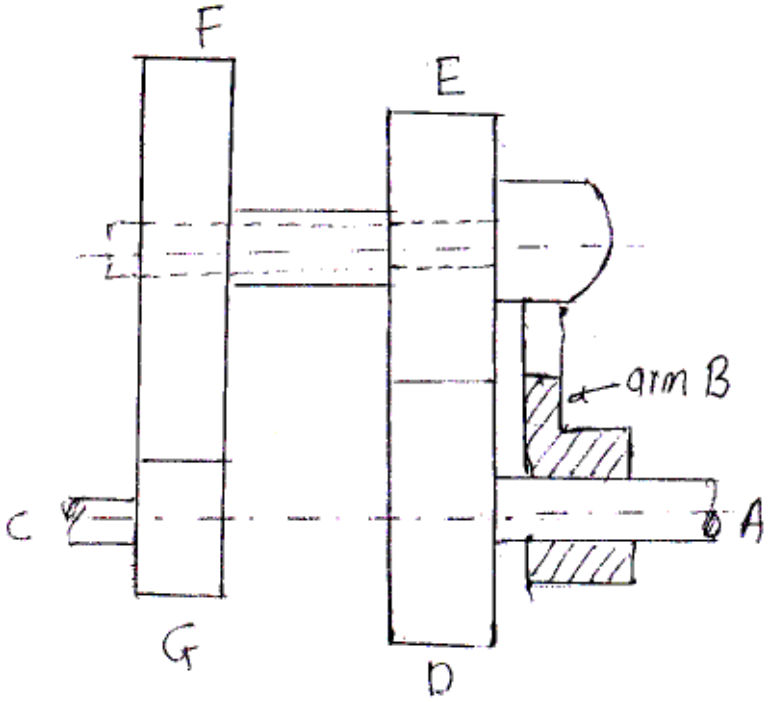

Fig. 1

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T.E. (Mech.) (Semester – I) Examination, 2009
HEAT TRANSFER
(Common with Mech. S/W for Semester – II)
(2003 Course)

Time: 3 Hours Total Marks: 100

Instructions : *1) Answer **three** questions from Section **I** and **three** questions from Section **II**.*
*2) Answer to the **two** Sections should be written in **separate** books.*
*3) **Neat** diagrams must be drawn **wherever** necessary.*
*4) **Black** figures to the **right** indicate **full** marks.*
*5) **Use** of Electronic pocket Calculator is **allowed**. Use of external data books is **not** allowed.*
*6) Assume suitable data, if **necessary**.*

SECTION – I
UNIT – 1

1. A) Explain 'Fourier's law of heat conduction'. **4**

B) Explain the difference between isotropic and anisotropic materials. **4**

C) A metal plate with dimensions 5m×3 m and negligible thickness has a surface temperature of 300° C. One side of it loses heat to the surrounding air at 30° C. Heat transfer coefficient between the plate surface and air = 20 W/m^2K. Emissivity of plate surface = 0.8. Calculate,

i) rate of heat loss by convection,

ii) rate of heat loss by radiation,

iii) combined convection + radiation heat transfer coefficient.

State the laws of heat transfer used in calculating the quantities in i) and ii) above. **8**

OR

2. A) State and explain 4 points of analogy between heat flow and electricity. **4**

   B) How does the thermal conductivity of an insulating material vary with temperature ? Explain with the help of suitable examples and sketches. **4**

   C) An insulating powder is densely packed in the annular space between two concentric spheres with radii 75 mm and 50 mm. The inner sphere is uniformly heated with electrical power input of 30 watts. Steady state temperature attained by the inner sphere is 120° C and that attained by the outer sphere is 30° C. Neglecting the thermal resistance offered by the spheres,

      i) draw analogous electrical circuit diagram of the system.

      ii) calculate the thermal conductivity of the insulating powder. **8**

UNIT – 2

3. A) A solid cylindrical fuel rod, 8 cm diameter and conductivity = 50 W/mK, generates heat at the rate of 2×10^5 W/m^3. If its centre-line temperature is 150°C, considering only radial conduction,

      i) Calculate its outer surface temperature,

      ii) Calculate rate of heat conducted at the outer surface per metre length of the rod,

      iii) derive the equation you use. **10**

   B) 'Insulating a hot cylindrical object radially, does not always reduce the heat loss from it'. Explain this statement with suitable sketch. **6**

OR

4. A) Derive an expression for temperature distribution in a solid sphere of radius 'R', conductivity 'k', centre temperature 'To', generating heat at a uniform rate of $\dot{q}$ W/m^3. **8**

   B) A plane composite slab with unit cross sectional area is made up of material 'A' (thickness = 100 mm, k_A = 60W/mk) and material 'B' (thickness = 10 mm, k_B = 2W/mk). Thermal contact resistance at their interface is 0.003 m^2 K/W. The temperature of open side of slab 'A' is 300° C and that of open side of slab 'B' is 50°C. Calculate,

      i) the rate of heat flow through the slab.

      ii) temperatures on both sides of the interface. **8**

UNIT – 3

5. A) A solid sphere of 1 cm radius made up of steel is initially at 300°C temperature.

Properties of steel :

k = 60 W/mk Density = 7800 kg/m^3

Sp. heat = 434 J/kg K

Calculate the time required for cooling it up to 50° C in the following two cases.

i) cooling medium is air at 25°C with h = 20 W/m^2 K.

ii) cooling medium is water at 25°C with h = 100W/m^2 K. **10**

B) Explain the principle of temperature measurement for a fluid flowing through a pipe using a thermowell.

Derive an expression for error in this temperature measurement. **8**

OR

6. A) Following are the specifications of an insulated end, circular cross sectioned tin.

Length = 25 cm

Diameter = 2.5 cm

Base surface temperature = 100° C.

Heat transfer coefficient between fin surface and surrounding air = 20 W/m^2 k

Temperature of surrounding air = 30°C.

Calculate the tip temperature of the tin if it is made up of,

i) copper with k = 380 W/mk

ii) brass with k = 110 W/mk. **10**

B) Explain the significance of Biot number in unsteady state conduction. Hence comment upon 'lumped parameter model'. **8**

SECTION – II

UNIT – 4

7. A) Write expressions for and physical significance of the following :

i) Prandtl number

ii) Grashoff number

iii) Reynold's number

iv) Rayleigh number **8**

B) A flat plate is 2 m long, 0.8 m wide and 3 mm thick. Density of plate = 3000 kg/m^3. Specific heat of plate material = 700 J/kg K. Its initial temperature is 80°C. A stream of air at 20°C is blown over both surfaces of the plate along its width, at a velocity 2 m/s. Calculate,

i) rate of heat dissipation from the plate.

ii) initial rate of cooling of the plate.

Properties of air :

$\rho = 1.09$ kg/m^3

$k = 0.028$ W/mk

$C_p = 1.007$ kJ/kg k.

$\mu = 2.03 \times 10^{-5}$ kg/ms

$Nu = 0.664\ Re^{0.5}\ Pr^{0.3333}$ **8**

OR

8. A) i) Explain the difference between natural convection and forced convection.

ii) Define and explain :

. Nusselt number

. 'Characteristic length' in forced convection heat transfer. **8**

B) A horizontal cylindrical rod of 4 cm diameter and 60 cm length is initially at a temperature of 124° C. Calculate the rate of heat lost from it, if it is exposed to still water at 30°C.

$Nu = 0.53\ Ra^{1/4}$ for $10^4 < Ra < 10^9$

$= 0.13\ Ra^{1/3}$ for $10^9 < Ra < 10^{12}$.

Properties of water :

Cp = 4191 J/kg K

k = 0.668 W/mk

$\mu = 3.72 \times 10^{-4}$ kg/ms.

$\rho = 973.7$ kg/m^3

$\beta = 6.286 \times 10^{-4}$/k **8**

UNIT – 5

9. A) Write short notes on : **8**

i) Wien's displacement law

ii) Radiation shield

B) A cylindrical heater element with diameter = 2 cm has emissivity = 0.7. It is kept at 727°C. It is located in a large room whose walls are maintained at 27°C. Find the rate of radiant heat transfer per unit length from the heater towards the walls of the room.

If the heater is enclosed in another pipe at 27°C, with diameter = 200 mm and emissivity = 0.2, what is the rate of radiant heat transfer ? **8**

OR

10. A) Write short notes on : **8**

i) Shape factor

ii) Lambert's cosine rule.

B) Consider a black body at a temperature of 2000 K.

i) Calculate its total hemispherical emissive power ;

ii) Calculate the wavelength at which maximum emissive power is available from this body.

State and explain the laws of radiation, which you have used to calculate the above mentioned quantities. **8**

UNIT – 6

11. A) Explain the mechanism of,

i) Film boiling,

ii) nucleate boiling,

iii) Natural convection boiling. **9**

B) A steam condenser is designed to condense 0.76 kg/min. of steam with cooling water entering at 20°C and leaving at 65°C. Overall heat transfer coefficient = 3400 W/m^2k. Calculate the surface area required for this heat exchanger. Saturation temperature of steam = 95.6°C. $h_{fg\ steam}$ = 2270 kJ/kg. **9**

OR

12. A) Write short notes on :

i) Compact heat exchangers

ii) Critical heat flux

iii) Dropwise condensation process **9**

B) A counter flow double pipe heat exchanger is used to heatwater from 20°C to 40°C by cooling an oil from 90°C to 55°C. The exchanger is designed for a total heat transfer rate of 59 kw with overall heat transfer coefficient of 340 W/m^2k. Calculate the surface area required.

If the oil is dirty, which creates a fouling factor on oil side of the heat exchanger, what will be the effect on total heat transfer rate ? Why ? **9**

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T.E. (Mechanical) (Semester – I) Examination, 2009
DESIGN OF MACHINE ELEMENTS
(2003 Course)

Time : 4 Hours Max. Marks : 100

Instructions : *1) Answers to the **two** Sections should be written in **separate book**.*
*2) Neat diagrams must be drawn **wherever** necessary.*
*3) Black figures to the **right** indicate **full** marks.*
*4) **Use** of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*5) Assume suitable data, **if necessary**.*

SECTION – I

Unit – I

1. a) Explain with suitable examples, the phases involved in the process of machine design. **4**

   b) What is design analysis and optimization. **4**

   c) Explain creativity in Design. **4**

   d) State important requisites of a design engineer. **4**

OR

2. A lever - loaded safety valve is mounted on the boiler to blow off at a pressure of 1.5 mPa gauge. The effective diameter of the opening of the valve is 50 mm. The distance between the fulcrum and the dead weights on the lever is 1000 mm. The distance between the fulcrum and the pin connecting the valve spindle to the lever is 100 mm. The lever and pin are made of plain carbon steel 30C8 (s_{yt} = 400 N/mm^2) and the factor of safety is 5. The permissible bearing pressure at the pins in the lever is 25 N/mm^2. The lever has a rectangular cross-section and the ratio of width to thickness is 3:1. Design suitable lever for the safety valve. **16**

Unit – II

3. a) Draw a neat labelled sketch of a "protected type flange coupling". State the dimensions of the coupling as standard proportions in terms of shaft diameter. **8**

b) A standard splined connection 8×52×60mm is used for the gear and the shaft assembly of a gear - box. The splines transmit 20 kW power at 300 rpm. The dimensions of the splines are as follows : **8**
Major diameter = 60 mm
Minor diameter = 52 mm
Number of splines = 8

Permissible normal pressure on spline is 6.5 N/mm^2. The coefficient of friction is 0.06. Calculate :

i) The length of hub of the gear
ii) The force required for shifting the gear.

OR

4. a) "A square key is stronger against crushing than rectangular key". Justify the statement. **6**

b) What is Castigliano's theorem ? Determine the deflection of a cartilever beam of length 'L' under the force 'F' acting at the free end by using Castigliano's theorem. Assume flexural rigidity. **10**

Unit – III

5. a) State the advantages and limitations of the welded joint over rivetted joints. **4**

b) Explain bolts of uniform strength with neat diagram. **6**

c) Prove that normal stress in case of annular fillet weld subjected to bending is given by : **8**

$$\sigma_B = \frac{5.66 M_B}{rhD^2}$$

Where,
M_B = Bending moment
h = Weld size
D = Diameter of circular piece

OR

6. a) What is preloading of bolts ? State its advantages and applications. **4**

b) Draw neatly in two views, the locking arrangement using **6**

i) Split pin
ii) Castle nut, and
iii) Grub screw

c) Explain types of welded joints. **4**

d) Draw a neat diagram of a turn buckle Showing various dimensions to be designed. **4**

SECTION – II

Unit – IV

7. a) In a machinist vice, a screw with single start, square threads with 22 mm nominal diameter and 5 mm pitch is used. A friction collar provided in the body has inner and outer diameters as 45 mm and 55 mm respectively. The coefficient of friction for both the threads and the collar, is 0.15.

The operator can apply 100 N force on the handle which is 150 mm long. Assuming uniform wear for the collar. Calculate

i) Clamping force developed ii) Overall efficiency. **8**

b) Explain the condition of self locking for a square threaded screw. **5**

c) Compare V threads, square threads and trapezoidal threads for power transmission. **4**

OR

8. a) A two start, trapezoidal screw is used in a screw jack to raise a load of 300 N. The screw has nominal diameter as 100 mm, pitch as 12 mm and helix angle of 15°. Coefficient of friction in screw threads is 0.15. Neglecting collar friction, calculate

i) Torque required to raise the load.
ii) Torque required to lower the load
iii) Screw efficiency. **9**

b) Explain the procedure to calculate nut height in a power screw and nut assembly. **4**

c) State and justify the material choice for screw, nut and power screw body. **4**

Unit – V

9. a) A machine component made of steel (ultimate tensile strength = 630 MPa) has a rectangular cross section 50 mm × 10 mm. It is subjected to a completely reversed, axial force of 'P' N. Expected reliability is 90% and corresponding factor is 0.89%. Factor of safety is 2. Following factors can be assumed : Surface finish factor = 0.8 Notch sensitivity = 0.8 Size factor = 0.85

Theoretical stress concentration factor = 2.25

Find the force 'P' corresponding to infinite life expectation. What will be the maximum force if the expected life is only 50000 cycles ? **10**

b) Draw the Soderberg and Goodman diagrams for fatigue analysis and compare them. **7**

OR

10. a) What is 'Cumulative fatigue damage' ? Explain with relevant diagram. **4**

    b) A circular transmission shaft is subjected to a bending stress varying from –50 to +50 N/mm^2, and a torsional shear stress of 25 N/mm^2. Frequency of stress variation is same as shaft speed. Shaft is made of medium carbon steel with ultimate tensile strength of 630 MPa and yield strength of 475 MPa. Determine the factor of safety guarding against failure by Soderberg and Goodman approach. Following factors can be assumed

    Size factor = 0.85 Surface finish factor = 0.9

    Reliability factor = 0.897 Notch sensitivity = 0.75

    Theoretical stress concentration factor = 2 **10**

    c) Discuss the fatigue analysis of helical compression springs. **3**

Unit – VI

11. a) Derive the expressions for the stress and deflection in a helical compression spring. **6**

    b) Design a helical compression spring for a maximum load of 1200 N corresponding to the deflection of 25 mm. The spring index is 5. The maximum permissible stress for the spring material is 400 MPa. Assume Modulus of rigidity as 85 GPa. **6**

    c) State the desired properties of spring materials and give at least two examples of spring materials with compositions. **4**

OR

12. a) Derive the expressions for effective stiffness of two springs in series and in parallel . **4**

    b) Show that the bending stress in full length leaves is 50% more than that in graduated - length leaves in a multileaf spring. **6**

    c) A helical torsion spring is made from 5 mm diameter wire and it is a mean diameter of 60 mm. Number of effective turns are 5. Calculate the induced stress and angular deflection in degrees for the applied torque of 6 Nm. Spring material modulus of elasticity is 210×10^3 MPa. **6**

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T.E. (Mechanical S/W) (Sem. – II) Examination, 2009
PRODUCTION ENGINEERING
(Old) (1997 Course)

Time : 3 Hours | Max. Marks : 70

Instructions *: 1) Answer* ***any three*** *questions from* ***each*** *Section.*
2) Answers to the ***two*** *Sections should be written in* ***separate*** *books.*
3) Neat diagrams must be drawn ***wherever*** *necessary.*
4) Black figures to the ***right*** *indicate full marks.*
5) ***Use*** *of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is* ***allowed****.*
6) Assume suitable ***data****, if necessary.*

SECTION – I

1. a) Sketch the Tool terminology in ASA system in 3 views. **6**
   b) Draw the Menchants force circle. **4**
   c) Explain the design of single point turning tool. **6**

2. a) Sketch the cutting teeth nomenclature in broach tool. **6**
   b) Explain with neat sketch the gear hobbing process for helical gears. **6**
   c) Explain in brief any four gear finishing process. **4**

3. a) Explain in brief three types of thread rolling machines. **6**
   b) Explain in brief thread lapping and thread grinding. **4**
   c) Explain in brief Blow moulding and Extrusion moulding of plastics. **6**

4. a) Mention any six properties of plastics to be used as an engineering material. **6**
   b) Discuss the need and effects of surface treatment process. **4**
   c) Discuss in brief the process of Electroplating and Phosphating. **6**

5. Write short notes on **(any four)** : **18**
   a) Lathe tool dynamometer
   b) Form tools and their classification
   c) Gear generation process
   d) Cutting fluids
   e) Thread milling
   f) Injection moulding of plastics.

P.T.O.

SECTION – II

6. Explain in brief the following with setup sketch and principle **16**
   a) EDM b) EBM c) PAM d) USM

7. a) Mention the meaning of following NC codes **4**
      i) G 17 ii) G 33 iii) M 23 iv) M 06
   b) Differentiate between open and close loop NC system. **4**
   c) Discuss and differentiate CNC and DNC system. **8**

8. a) Differentiate between i) Punching and blanking ii) Bending and drawing. **4**
   b) What is a scrap strip layout ? Why it is required ? **4**
   c) How you will decide Blank size and force required in drawing operation ? **8**

9. a) Differentiate between jigs and fixtures. **4**
   b) Discuss 3-2-1 principle of location. **4**
   c) Draw the layout with minimum two views for a drilling jig using indexing mechanism to drill the holes located on PCD of any job but on inclined surface of job. Describe in brief. **8**

10. Write short notes on (**any four**) : **18**
    a) Milling fixtures
    b) FMS
    c) Machining centres
    d) Types of presses
    e) Diamond pin locator
    f) Compound die.

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T.E. (Mechanical) (Sem. – II) Examination, 2009
MECHANICAL MEASUREMENT AND CONTROL
(1997 Course)(Old)

Time : 3 Hours Max. Marks : 100

Instructions : *i) Attempt **any three** questions from **each** Section.*
*ii) Use **separate** answer sheet for **each** Section.*
*iii) **Neat** diagrams must be drawn **wherever** necessary.*
*iv) Figures to **right** indicate **full** marks.*
*v) **Use** of pocket calculator is **allowed**.*
*vi) Assume suitable data **if necessary**.*

SECTION – I

1. a) Explain any two static and dynamic characteristics of measuring instruments. **8**

   b) Differentiate between following : **8**

      i) Accuracy and precision

      ii) Range and scale

      iii) Repeatability and reproducability

      iv) Sensitivity and Hysterisis.

2. a) Explain any two random and systematic errors with the help of suitable examples. **8**

   b) Discuss the selection criteria for measuring instruments. **8**

3. a) Plot and explain characteristic curve for LVDT. Explain any two applications of it. **8**

   b) What is RTD ? How it differs from thermocouple ? Explain characteristics of RTD. **8**

4. a) Explain electro-mechanical type pressure transducers. State its applications. **8**

   b) Differentiate between feedback and feedforward control system. **8**

P.T.O.

5. Write a short note on **any three** of the following : **18**
   i) Noise measurement
   ii) Open and close loop control systems
   iii) Flow measurement
   iv) Servomechanism
   v) PID controller.

SECTION – II

6. a) Explain the various types of control valves. **8**

   b) Plot and explain the characteristics of control valves. **8**

7. a) Explain P+D controller with the help of suitable example. **8**

   b) Explain the various types of actuators. Explain any one in detail with suitable diagram. **8**

8. a) Explain structure of PLC with the help of suitable block diagram. **8**

   b) Differentiate between PLC and microprocessor. Also discuss any one major application of microprocessor. **8**

9. a) Explain the automatic control system for boiler temp. control. **8**

   b) Discuss any two applications of control valves in detail. **8**

10. Write a short note on **any three** from the following : **18**
   i) Specifications of PLCs
   ii) SCADA
   iii) Timers and counters in PLCs
   iv) I to P converter
   v) Displacement measurement.

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T.E. (Mech./Mech. S/W) (Semester – II) Examination, 2009
APPLIED THERMODYNAMICS – II
(1997 Course) (Old)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **any 3** questions from **each** Section.*
*2) Answers to the **two** Sections should be written in **separate** books.*
*3) Neat diagrams must be drawn **wherever** necessary.*
*4) Black figures to the **right** indicate **full** marks.*
*5) Use of logarithmic tables, Slide rule, Mollier charts, electronic pocket calculator and steam tables is **allowed**.*
*6) Assume suitable data, if **necessary**.*

SECTION – I

1. a) Derive an expression for loss of available energy due to heat transfer through a finite temperature difference. **6**

   b) Define :
   Available energy, Unavailable energy. **4**

   c) Explain second law efficiency and irreversibility. **6**

2. a) Define one ton refrigeration. **2**

   b) Explain Bell-Colemn cycle with P-V and T-S diagram. Also derive expression for cop. **8**

   c) Explain vapour absorption refrigeration system with a neat sketch. **6**

3. a) Write a note on alternative fuels for I.C. engines. **5**

   b) What are the important qualities of S.I. engine fuels ? **6**

   c) Write a note on retining of crude petroleum. **5**

4. a) Discuss stages of combustion in S.I. engines. **6**

   b) Explain
   Octane Number
   Cetane Number. **4**

   c) Explain any one combustion chamber used for CI engine with a neat sketch. **6**

P.T.O.

5. Write short notes on **any three** of the following : **18**

   a) Availability of non flow and steady flow system.

   b) Desirable properties of refrigerants.

   c) Ice manufacturing.

   d) Stages of combustion in C.I. engines

   e) Detonation and knock.

SECTION – II

6. a) Define Air conditioning. **2**

   b) Compare :

   Central Air conditioning and Unitary Air conditioning. **5**

   c) Explain psychrometric chart with a neat sketch. **5**

   d) What are the factors affecting human comfort ? **4**

7. a) Write a note on classification of rotary air compressors. **4**

   b) Compare : Rotary compressors and Reciprocating compressors. **5**

   c) Name various applications of rotary compressors. **2**

   d) Explain surging. **5**

8. a) Explain : Supercharging and Turbocharging. **4**

   b) What are the limitations of supercharging in C.I. engines ? **4**

   c) Discuss the need of supercharging of I.C. engines. **4**

   d) What is a supercharger ? Name the superchargers used in I.C. engines. **4**

9. a) What are the sources of emissions from S.I. engines ? **5**

   b) What is a catalytic convertor ? Explain with a neat sketch. **7**

   c) Explain emission norms for the year 2000. **4**

10. Write short notes on **any three** of the following :

   a) Humidification and dehumidification.

   b) Characteristic curves for rotodynamic compressors.

   c) Limitations of supercharging in S.I. engines.

   d) Harmful effects of I.C. engine emissions.

   e) Psychrometric processes. **18**

T.E. (Mech.) (Sem. – II) Examination, 2009
METROLOGY AND QUALITY CONTROL
(2003 Course)

Time : 3 Hours

Max. Marks : 100

Instructions : *1)* ***All*** *questions are* ***compulsory.***
2) Figure to ***right*** *indicate* ***full*** *marks.*
3) ***Assume*** *suitable data if* ***necessary.***

SECTION – I

1. a) Differentiate between line and end standards. **8**

   b) Define straightness, flatness, squareness and roundness. **8**

OR

1. a) Design and make a drawing of general purpose 'Go' and 'NoGo' plug gauge for inspecting a hole of 25 D_8. Data with usual notations.

   i) i (micron) = $0.45\sqrt[3]{D} + 0.001$ D (D is in mm)

   ii) The fundamental deviation for hole D = $16\ D^{0.44}$.

   iii) The value of tolerance for IT8 = 25i **10**

   b) Explain Taylor's Principle of Gauge Design. **6**

2. a) Explain construction, working, applications, advantages and limitations of Johansson's Microkator. **8**

   b) Explain N.P.L. Flatness Interferometer. **8**

OR

2. a) Calculate the effective diameter for $M_{24} \times 3$ plug gauge by using floating carriage micrometer for which readings were taken as below.

   1) Diameter of Standard Cylinder 22.001 mm.

   2) Micrometer reading over standard cylinder with two wires of same diameter was 12.9334 mm.

   3) Micrometer reading over plug screw gauge with wires was 12.1124 mm. Best wire size was used for the above measurement. Neglect rake and compression errors. **8**

b) Derive the Relation for Best wire size. For M 24×3 mm external threads, calculate the diameter of the best size and the difference between the size under wires and the effective diameter. 8

3. a) Calculate the setting of David Brown tangent comparator to measure the distance over three of a spur gear with module of 2.5 mm, 20° pressure angle and 30 teeth, ignoring any back-lash allowance. What will be the size when the back-lash allowance on single gear is 0.1 mm normal to the tooth flank. 8

b) For a 14.5° pressure angle gear having 30 teeth and 3 mm module, calculate

1) Roller size

2) Distance over the rollers in opposite spaces.

3) Distance over the rollers spaced 6 teeth apart. 8

c) Calculate chord length for gear and distance below tooth tip.

Module 5 mm and pressure angle 20°. 2

OR

3. Write short notes on followings : 18

a) Co-ordinate Measuring Machine.

b) Alignment Test on Lathe Machine

c) Span micrometer.

SECTION – II

4. a) Differentiate between 'Quality design' and 'Quality of conformance'. 6

b) What is the difference between quality control, quality assurance, and inspection and testing ? 10

OR

4. a) Compare the variable chart and attribute chart. 6

b) The number of defects found in each sample of cloth of 1sq. mm area are noted down as follows. Draw the appropriate control chart and check that the process in control or not.

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
No. of defects found	8	9	5	8	5	9	9	11	8	7	6	4

10

5. a) For the following data, calculate the sample size and AOQ for single sampling plan.

1) Probability of acceptance for 0.4% is 0.558.

2) Lot size N = 10,000 units

3) Acceptance number C = 1

4) np = 1.5

5) Defectives found in the samples are not to be replaced. 8

b) Explain the characteristics of O.C. curve. 8

OR

5. a) Compare the Single sampling, Double sampling and Multiple sampling plan. 8

b) The following are $\overline{X}$ and R values for 20 subgroups of 5 readings :

$\overline{X}$: 34.0, 31.6, 30.8, 33.0, 35.0, 33.2, 33.0, 32.6, 33.8, 37.8, 35.8, 38.4, 34.0, 35.0, 33.8, 31.6, 33.0, 28.2, 31.8, 35.6.

R : 4,4,2,3,5,2,5,13, 19, 6,4,4,14,4,7,5,5,3,9,6.

The specification limits for components are 40.37 ± 0.1. Establish control limits for $\overline{X}$ and R chart will the product meet specification. 8

6. Write short notes (**any three**) : 18

a) DMAIC

b) FMECA

c) ISO9001

d) Sequential sampling

e) Quality Audit.
