B.TECH. (IV SEMESTER) EXAMINATION
(MECHANICAL ENGINEERING)
NUMERICAL METHODS & OPTIMIZATION
AM-232

Maximum Marks: 60  Credit: 04  Duration: Three Hours

Note: (i) Answer all the questions.
(ii) Programmable calculators are not allowed.
(iii) Do all the calculations up to four decimals.

1(a) Show that the equation
\[ f(x) = \cos \left( \frac{\pi (x + 1)}{8} \right) + 0.148x - 0.9062 = 0 \]
has one root in the interval (-1, 0) and another root in (0, 1). Calculate the positive root correct to four decimals by Newton-Raphson method. [5]

1(b) Determine \( p, q \) and \( r \) so that the order of the iterative method
\[ x_{n+1} = px_n - \frac{qa}{x_n^2} + \frac{ra^2}{x_n} \]
for \( a^{1/5} \) becomes as high as possible.

OR

1(b') Calculate the approximate value of \( a \) to ensure the fastest possible convergence of the iterative scheme
\[ x_{n+1} = \frac{ax_n + x_n^{-2} + 1}{a + 1} \] [5]

1(c) Perform three iterations of Gauss-Seidel method and find the approximate solution of the following system of equations
\[ x_1 + 2x_2 - 3x_3 = -4 \]
\[ x_1 + 5x_2 + 2x_3 = -6 \]
\[ 4x_1 + x_2 + x_3 = 2. \]

Take the initial approximation as \( x^{(0)} = (0.5, -0.5, -0.5)^T \). [5]

Could………2
2(a) Form the divided difference table for the data given below:

\[
\begin{array}{cccccc}
  x & -4 & -3 & -2 & 3 & 5 \\
  f(x) & -3 & 8 & 7 & 32 & 168 \\
\end{array}
\]

Use this table to find the interpolating polynomial that fits this data.

2(b) The following data gives corresponding values of pressure and specific volume of a superheated stream.

\[
\begin{array}{cccccc}
  V & 2 & 4 & 6 & 8 & 10 \\
  P & 105 & 42.7 & 25.3 & 16.7 & 13 \\
\end{array}
\]

(i) Find the rate of change of pressure with respect to volume when \( V = 2.5 \).
(ii) Find the rate of change of volume with respect to pressure when \( P = 13 \).

OR

2(b') For what values of \( \lambda_1, \lambda_2 \) and \( x_1 \) the quadrature formula

\[
\int_{-1}^{1} f(x) \, dx = \lambda_1 f(-x_1) + \lambda_2 f(0) + \lambda_3 f(x_1)
\]

is exact for polynomials of highest possible degree? Use this formula to evaluate \( \int_{0.2}^{0.8} \cos h \left( \frac{x \sin^2}{3} \right) \, du \).

3(a) Solve the initial value problem

\[
\frac{dy}{dx} = x + 0.1 y^2, \quad y(1.2) = 1.02, \quad 1.2 \leq x \leq 1.4,
\]

by (i) Runge-Kutta method of order 4 with \( h = 0.2 \).

OR

(ii) Modified Euler's method with \( h = 0.2 \). Perform three iterations.

3(b) Solve by finite difference method the boundary value problem

\[
\frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} + 3y = xe^x, \quad y(0.2) = 1, \quad y'(0.8) = 0
\]

Take \( h = 0.2 \).

4(a) Formulate the dual of the following linear programming problem

\[
\text{Max} \, Z = 240 x_1 + 104 x_2 + 60 x_3 + 19 x_4
\]

subject to

\[
\begin{array}{l}
20x_1 + 9x_2 + 6x_3 + x_4 \leq 20 \\
10x_1 + 4x_2 + 2x_3 + x_4 \leq 10 \\
x_1, x_2, x_3, x_4 \geq 0
\end{array}
\]

and then solve it by graphical method.
4(a)

There are two types of food, Corn and Soybean, that supply varying quantities of two nutrients, protein and fiber, essential to good health, given in the following table:

<table>
<thead>
<tr>
<th>Foods</th>
<th>Protein</th>
<th>Fiber</th>
<th>Cost (Rs./gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>0.09</td>
<td>0.02</td>
<td>0.30</td>
</tr>
<tr>
<td>Soybean</td>
<td>0.60</td>
<td>0.06</td>
<td>0.9</td>
</tr>
</tbody>
</table>

A person uses at least 800 gm mix of two foods daily. The daily dietary requirement of nutrients is at least 30% protein and at most 5% fiber. Formulate the linear programming problem that minimizes the cost of mix of two foods per day also solve it graphically.

4(b)

Solve, by simplex method, the linear programming problem:

\[ \text{Max } Z = 5x_1 + 3x_2 + 7x_3 \]

subject to

\[
\begin{align*}
    x_1 + x_2 + 2x_3 & \leq 22 \\
    -3x_1 - 2x_2 - x_3 & \geq -26 \\
    x_1 + x_2 + x_3 & \leq 18 \\
    x_1, x_2, x_3 & \geq 0.
\end{align*}
\]
2012-13
B.TECH. IV SEMESTER EXAMINATION
MECHANICAL ENGINEERING
ELECTRICAL TECHNOLOGY (EE – 204)
Credits: 04

Maximum Marks: 60
Duration: Three Hours

Answer all questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.N. Question

1. (a) Derive the expression for torque developed by a three phase induction motor.
     Explain the torque-slip characteristics and discuss the meaning of ‘Stable and
     Unstable’ operation of motor.

     (b) The power input to a 400V, 50 Hz, Y connected, 6 pole, three phase induction
         motor running at 950 rpm is 40 kW at 0.8 power factor lagging. The stator iron
         loss is 0.4 kW and stator copper loss is 0.6 kW. The value of friction and
         windage losses is 2 kW. Calculate:
         (i) rotor copper loss
         (ii) efficiency
         (iii) input line current

     OR

1. (a) Why a three phase induction motor has large value of starting current and why it
     is not desirable? Explain ‘Auto transformer’ and ‘Rotor Resistance’ methods of
     starting of three phase induction motors.

     (b) A 3 phase, 50 Hz, 400V, star connected, 4 pole induction motor has a stator to
         rotor turn ratio of 2. The rotor resistance and standstill reactance per phase are
         0.1 and 1.0 ohm respectively and the full load slip is 4 percent. Calculate:
         (i) total torque developed
         (ii) maximum torque
         (iii) speed at maximum torque

2. (a) Explain why a three phase synchronous motor is not self starting.

2. (b) How a three phase synchronous motor can be started with the help of damper
       windings?

2. (c) Explain the construction, principle of operation and applications of a Universal
       Motor.

3. (a) An industrial consumer has a maximum load of 240 kW at 0.8 lagging power
       factor with an annual consumption of 50,000 units. The tariff is Rs 500 per kVA
       maximum demand plus Rs 1 per unit of energy consumed. Determine the flat
       rate of energy consumption.

Contd.………2
(b) A single phase induction motor connected to a 240 V, 50 Hertz supply takes 20 Ampere at a power factor of 0.75 lagging. A capacitor is connected across the terminals of the motor to improve its power factor to 0.9 lagging. Determine the capacitance of the capacitor to be used.

4.(a) Discuss the speed-current, torque-current, and torque-speed characteristics of a d.c. shunt motor. Explain why this motor is called as constant speed motor?

(b) A 250 V d.c. shunt motor having a field resistance of 125 Ohms and armature resistance of 1 Ohm takes an armature current of 25 A while running at a speed of 900 r.p.m. Find the additional resistance of field regulator to increase the speed of machine to 1100 r.p.m., keeping the torque constant. Assume the linear relationship between the field current and the flux produced.

OR

4'(a) Giving a neat diagram discuss the Ward Leonard method of speed control of d.c. motors. Discuss its merits and demerits.

(b) Why does a d.c. series motor produce a high starting torque? Mention industrial applications of this motor.

5.(a) Write full name of following power electronic devices:
     \text{BJT, MOSFET, IGBT, SIT, GTO, RCT, SITH, LASCR}

(b) Supporting with suitable data, differentiate clearly between a signal diode and a power diode.

(c) Discuss v-i characteristic of a semi-conductor power diode. Discuss the suitability of power diode as an ideal switch in an electronic circuit.

OR

5'(a) Giving neat diagram discuss v-i characteristics of a Silicon Controlled Rectifier.

Giving wave shapes of input voltage, output voltage, and output current discuss the working of a single phase half wave rectifier circuit. Determine the average and r.m.s. values of the output voltage wave.
UNIT – I

1. You bought a laptop from DELL VISION, ALIGARH with a warranty of two years. After six months you discover that the screen gets blurred every now and then and the sound system is also giving trouble. Write a letter to the dealer complaining about the problem and requesting him to get the defects repaired or replace it.

OR

Write a job application and create your CV in response to the following advertisement:

THE HINDU

May 10, 2013

THE GULF ENGINEERING SERVICES
19, K.G. Marg, New Delhi

Applications are invited from all branches of fresh engineering graduates to work in different projects such as Metro Rail, Oil Fields etc. in Saudi Arabia. Apply with a detailed CV.

Excellent communication skills in English is a must. Working knowledge of Arabic will be an added advantage. Those who do not have a valid passport need not apply.

Last Date: May 30, 2013

UNIT – II

2. Define and draft any one of the following business messages assuming an appropriate business situation.

(a) Telex
(b) Memo
(c) e-mail

UNIT – III

3. Make note or write an abstract of the following passage:

- The Scandinavian countries are much admired all over the world for their enlightened social policies. Sweden has evolved an excellent system for protecting the individual citizen from high-handed or incompetent public officers. The system has worked so well that it has been adopted in other countries like Denmark, Norway, Finland and New Zealand. Even countries with large populations are now seriously considering imitating the Swedes.
-2-

• The Swedes were the first to recognize that public officials like civil servants, police officers, health inspectors or tax collectors can make mistakes or act over-zealously in the belief that they are serving the public. As long ago as 1899, the Swedish Parliament introduced a scheme to safeguard the interest of the individual. A parliamentary committee representing all political parties appoints a person who is suitably qualified to investigate private grievances against the State. The official title of the person is 'Justitieombudsman', but Swedes commonly refer to him as the 'J.O.' or 'Ombudsman'.

• The Ombudsman is not subject to political pressure. He investigates complaints large and small that come to him from all levels of society. As complaints must be made in writing, the Ombudsman receives an average of 1200 letters a year. He has eight lawyer assistants to help him, and he examines every single letter in detail. There is nothing secretive about the Ombudsman's work, for his correspondence is open to public inspection. If a citizen's complaint is justified, the Ombudsman will act on his behalf. The action he takes varies according to the nature of the complaint. He may gently reprimand an official or even suggest to Parliament that a law be altered. The following case is a typical example of the Ombudsman's work.

• A foreigner living in a Swedish village wrote to the Ombudsman complaining that he had been ill-treated by the police, simply because he was a foreigner. The Ombudsman immediately wrote to the Chief of Police in the district asking him to send a record of the case. There was nothing in the record to show that the foreigner's complaint was justified and the Chief of Police stoutly denied the accusation. It was impossible for the Ombudsman to take action on the complaint, but when he received a similar complaint from another foreigner in the same village, he immediately sent one of his lawyers to investigate. The lawyer ascertained that a policeman had indeed dealt roughly with foreigners on several occasions. The fact that the policeman was prejudiced against foreigners could not be recorded in the official files. It was only possible for the Ombudsman to find this out by sending one of his representatives to check the facts on the spot. The policeman in question was severely reprimanded and was informed that if any further complaints were received against him, he would be prosecuted. The Ombudsman's prompt action in the matter at once put an end to an unpleasant practice which might have gone unnoticed.

UNIT – IV

4. Generate a group discussion choosing one of the following topics with at least four participants.
   (a) The changing value system – a need for re-orientation
   (b) The future of information technology
   (c) Increasing crime against women in India: Causes and ways to curb.

UNIT – V

5. Write the transcript of a telephonic conversation you had with the receptionist of a Guest House in Bangalore to book a room for three days as you are going there to attend a seminar.

OR

Reproduce the transcript of a job interview you have attended recently with three interviewers as a fresher.
2012-13
B.TECH. (WINTER SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MATERIALS SCIENCE

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.NO. Question M.M.
1. Answer the following:
   I. What is the effect of grain structure and grain size on properties of metals?
   II. Distinguish between amorphous and crystalline substances.
   III. Explain any two types of point defect found in solid materials.
   IV. Explain the terms: tilt boundary and twin boundaries. [12]

2. (a) What are the specific useful properties of non ferrous metals? [04]
   (b) Write a detailed note on aluminum and its alloys discussing their various compositions, properties and applications. [08]

OR

2'. Discuss briefly the compositions and properties of:
   I. Phosphor bronze II. Qua metal and Bell metal III. Monel metal
   IV. German silver V. Nichrome VI. Inconel. [12]
3. What is heat treatment and for what purpose it is done? Explain the following heat treatment processes in detail:
   I. Hardening               II. Case hardening               III. Flame hardening [12]

OR

3'. Explain in detail iron-carbon equilibrium diagram indicating the different phases. Also explain the following terms:
   I. Cementite                II. Ferrite                  III. Austenite                  IV. Pearlite [12]

4. (a) A glass plate contains an atomic-scale surface crack (take crack-tip radius as diameter of an O₂). Given that the crack tip is 1 μm long and the theoretical strength of the defect-free glass is 7.0 GPa. Calculate the breaking strength of the plate. [04]

(b) Describe, for cyclic loading, the mechanism of ductile mode of fracture. [04]

(c) Sketch and explain the creep curve. [04]

5. Explain the term corrosion. Explain in detail the acid theory and chemical attack theory of corrosion. [12]

OR

5'. Write short notes on:
   I. Galvanizing              II. Tinning
   III. Inorganic coatings     IV. Organic coatings [12]
2012-13
B.TECH. (WINTER SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MACHINE DRAWING AND COMPUTER GRAPHICS
ME-211

Maximum Marks: 40
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.          Question                          M.M.

1(a)          Draw the conventional representation of the following:
              (i) Asbestos  (ii) Wood
              (iii) Holes on circular pitch  (iv) Straight knurling

1(b)          Define Concatenation with the help of a suitable example.

1(c)          A triangle is defined in a two-dimensional Interactive Computer Graphics System
              by its vertices (0, 2), (0, 3) and (1, 2). Perform the following transformations on this
              triangle:
              (i) Translate the triangle in space by 2 units in the x-direction and 5 units in the y-
                   direction.
              (ii) Scale the triangle as obtained in (i) by a factor of 1.5 in both the coordinate
                   directions.
              (iii) Scale the original triangle by a factor of 1.5 in the x-direction and 3.0 in the y-
                   direction.
              (iv) Rotate the original triangle by 45° about the origin.

2            Fig. 1 shows the part details of a Bench Vice. Assemble the parts and draw the Full
              Sectional Elevation and Right End View of the assembly.

OR

2*           Draw the Full sectional Elevation and Plan of the Non Return Valve assembly for
              which the part details are shown in Fig. 2.
Fig. 1: BENCH VICE

Contd.......

3
Fig. 2: NON-RETURN VALVE
2012-13
B.TECH. (IV SEMESTER) EXAMINATION
MECHANICAL
MACHINE DESIGN
ME-212

Maximum Marks: 60
Credits: 05
Duration: Three Hours

Answer all the questions:
Assume suitable data if missing.
Notations used have their usual meaning.

1(a) Distinguish between the following:
   (i) Dead load and Live load
   (ii) Shock load and Impact load
   (iii) Compressive stress and Contact stress/Bearing stress

1(b) What is maximum distortion energy theory? Derive its expression for a general state of stress. Also, show that under combined state of stress system, maximum shear stress theory predicts 15% less yield stress than the maximum distortion energy theory.

2(a) What is meant by endurance strength of a material?
2(b) What is fatigue stress concentration factor?
2(c) Explain the difference among completely reversed, repeated and fluctuating stress cycles.
2(d) What is Goodman's criterion for combination of stresses? Obtain the relation of factor of safety, including the fatigue stress concentration factor, applicable to brittle materials as per Goodman's criterion.

3 A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250mm and 400 mm respectively from the centre line of the right and left bearings. The pitch diameters of the gear C are 600 mm and that of gear D is 200mm. The distance between the centre lines of the bearings is 2400mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure \( P_{tc} \) of the gear C and \( P_{td} \) of the gear D act vertically downwards.

Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gears C and D weigh 950N and 350N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively.
3'(a) Explain, with the help of neat sketch, what is a split Muff coupling? Obtain the expression for the frictional torque to be transmitted by a split Muff couplings.

3'(b) Design a split Muff coupling to transmit 50 kW at 150 rpm. The allowable shear stress for the shaft and the key is 50 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for bolts is 90 MPa. The coefficient of friction between the Muff and the shaft surface can be taken as 0.3.

4(a) In case of power screws, drive the expression for the torque required to raise load by square threaded screws. Also, prove that maximum efficiency of a square threaded screw is given by

\[ T = \frac{1 - \sin \phi}{1 + \sin \phi} \]

4(b) A vertical two start square threaded screw of a 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 KN. The axial thrust on the screw is taken by a collar bearing of 250 mm outside diameter and 100 mm inside diameter. Find the force required at the end of a lever which is 400 mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.2.

OR

4(b)' A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover 1.25 N/mm². Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in the studs as 33 MPa.

5(a) What are flexible machine elements? What are the advantages, disadvantages and uses of belt drives?

5(b) Explain, the slip in case of flat belt?

5(c) Drive the relation for the ratio of tensions for a flat belt drive.

OR

5(c)' Drive the relation for the ratio of tensions for a V-belt drive.

5(d) A flat leather belt 9 mm x 250 mm is used to drive a cast iron pulley 900 mm in diameter at 336 rpm. If the active arc on the smaller pulley is 120° and the stress in tight side is 2 MPa, find the power capacity of the belt. The density of leather may be taken as 980 kg/m³, and the coefficient of friction of leather on cast iron is 0.35.
2012-13
B.TECH (WINTER SEMESTER) EXAMINATION
II yr (Mechanical)
Kinematics and Design of Machines
ME-215

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question

1(a) Explain any four of the following
(i) Toughness (ii) Resilience (iii) Creep (iv) Steel designated on the basis of Chemical
composition (v) types of steels on the basis of percentage of carbon

1(b) The following results were obtained in a tensile test on a mild steel specimen of original
diameter 22 mm and gauge length 45 mm.
Load at limit of proportionality = 82 KN, Extension at 82 KN load = 0.049 mm
Load at yield point = 86 KN, ultimate tensile stress = 400 N/mm²
When the two parts were fitted together after being broken, the new gauge length was
found to be 58 mm and the diameter at the neck was found to be 16 mm.
Calculate (i) Young's Modulus (ii) yield stress (iii) Maximum load (iv) Percentage
elongation in length and percentage reduction in area.

OR

1′(a) Explain any Two of the following
(i) Stress concentration due to holes and Notches (ii) Fatigue stress concentration factor
(iii) Notch sensitivity

1′(b) The figure (i) shows a rotating shaft supported in ball bearings at A and B and loaded
by a non rotating force of 7.5 KN. Estimate the life of the shaft if it is made of steel
having tensile strength of 690 MPa. Take form stress conc. factor K₁ = 1.65, Notch
sensitivity factor q = 0.9, Kₐ = 0.85, Kₑ = Kₙ = 1.

Contd....2
2(a) Explain any two of the following
(i) Length of path of contact (ii) Length of arc of contact (iii) Compound gear train

2(b) Two mating gears of 20° pressure angle have 18 and 36 teeth of module 8 mm. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine
(i) the addendum height for each gear wheel (ii) length of path of contact (iii) arc of contact (iv) contact ratio.

3(a) Explain any two of the following:
(i) Lower pair (ii) higher pair (iii) Kinematic Chain (iv) Inversion of mechanism.

3(b) Explain degrees of freedom of a mechanism and give its relation

3(c) Explain the Peaucellier mechanism to obtain the straight line motion OR

3(c') Describe with neat sketch the working of Davis Steering Gear mechanism. Also prove that for Davis steering gear the expression is
\[
\tan \theta = \frac{W}{2L}
\]
where \( W, \theta \) and \( L \) have their usual meanings.

4 The length of the crank and connecting rod of a horizontal reciprocating engine are 100 mm and 500 mm respectively. The crank is rotating at 400 rpm in clockwise direction. Using Klien's construction, find:
(i) Velocity and acceleration of the piston
(ii) Velocity and acceleration of mid-point of the connecting rod and
(iii) Angular velocity and angular acceleration of the connecting rod when the crank has turned 30° from the inner dead centre

5(a) Discuss the method to make a riveted joint air tight or leak proof. Also discuss the different type of failures of riveted joint.
5(b) Show that for zero collar friction, the efficiency of a square thread screw is given by the equation

\[ e = \frac{\tan \lambda - \mu \tan \lambda}{\tan \lambda + \mu} \]

OR

A bracket is bolted to a column by four bolts of equal size as shown in fig. (2). Determine the tensile stress area of the bolt, if the permissible shear stress is 140 MPa.