P1110   **[3564]-150**

B.E.
(Mech. S/W)
PRODUCTION MANAGEMENT (Elective - III)
(2003 Course) (402065)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) Answers to the two sections should be written in separate books.

2) Neat diagrams must be drawn wherever necessary.

3) 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.

6) All questions are compulsory.

SECTION - I

Q1) a) The following data refers to a sampling study of production of one component. **[6]**

i) Duration of data collection - 5 days of 8 hours.

ii) No. of operators - 10

iii) Allowances - 05%

iv) Total production in 05 days - 6000 units

v) Sampling data collected - as per table

Days –	1	2	3	4	5
No. of observations –	230	240	200	180	225
Occurrance of activity (working) –	200	190	170	150	210

Find standard time of the job if the average performance rating of the operator is 120% and the entire operation is manual.

b) Mention the economic & technical considerations in Method Study.**[5]**

c) Define 'qualified worker'. State the important characteristics of a qualified worker. **[5]**

OR

a) Define performance rating. Explain in brief various methods of performance rating. **[6]**

b) Mention the duties of on Industrial Engineer. **[5]**

c) Discuss in brief the various recording techniques used in Method Study. **[5]**

Q2) a) Explain the importance of Ergonomics. **[6]**

b) What is Man-Machine System? Explain with any suitable example. **[5]**

c) Define workspace design. Explain the principles involved in it. **[5]**

OR

a) Explain the effect on human performance due to - **[6]**

    i)   Heat & Cold

    ii)   High noise level.

    iii) Low & High Humidity.

b) Write a short note on 'Ergonomics & Safety'. **[5]**

c) Write a short note on 'antropometry'. **[5]**

Q3) a) What is group dynamics? How it can be benificial in quality management? **[9]**

b) Discuss in brief various costs associated with quality. **[9]**

OR

a) Discuss in detail PDCA cycle. **[9]**

b) Mention any nine points suggested by Dr. Deming for a change towards quality & productivity. **[9]**

SECTION - II

Q4) a) What is the difference between specification limits & control limits? **[4]**

b) What are 'R' charts? Explain in brief the steps involved in making 'R' charts? How these charts help the shop personnel? **[8]**

c) Define - i) AQL   ii) LTPD   iii) AOQ   iv) AOQL **[6]**

OR

a) Discuss "six steps towards six sigma process". **[9]**

b) Mention five standards of ISO 9000 series. **[5]**

c) Discuss first 4 pillars of TPM. **[4]**

Q5) a) What is BPR? Explain in brief the principles involved in it. **[8]**

b) What is Kaizen? What advantages an organisation can derive from implementation of Kaizen? **[8]**

OR

a) What is Bench Marking? Discuss the various levels of BM. **[8]**

b) Enlist seven QC tools & explain Pareto diagram with suitable example.
[8]

Q6) a) What is House of quality? What are QFD matrices? What are the benefits of QFD? **[8]**

b) What is Concurrent Engineering? Discuss the role of Information Technology & Computers in CE. **[8]**

OR

a) What is DFM & DFA? **[8]**

b) Define Value Engineering and Value Analysis. Mention the steps involved in VA. Differentiate between VE & Cost reduction techniques.
[8]

P1108   **[3564]-143**

B.E. (Mechanical) (Sandwich)
REFRIGERATION & AIR CONDITIONING (Elective)
(2003 Course) (402063)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

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) Figures to the right indicate full marks.

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

6) Assume suitable data, if necessary.

SECTION - I

Unit - I

Q1) a) Write a note on 'Steam Jet Refrigeration'. **[6]**

b) Define : One Ton Refrigeration. **[2]**

c) Explain Boot-Strap system with the help of T-S diagram. Derive expression for cop. **[8]**

OR

Q2) a) In a Bell-Colemn cycle, air enters the compressor at 100 kPa & 15ºC. The pressure ratio is 12. Air enters the expander after cooling at 15ºC. Determine the cop of the cycle and power consumption per kW of refrigeration. **[6]**

b) Write a note on refrigeration by throttling of gases. **[4]**

c) Explain reversed carnot cycle used for refrigeration with the help of T-S diagram. Derive an expression for cop. **[6]**

Unit - II

Q3) a) Explain vapour compression refrigeration cycle with the help of p-h diagram. **[5]**

b) Explain:
i) GWP
ii) ODP **[5]**

c) Compare the cop of ammonia refrigeration system which uses wet compression with one which uses dry compression & operates between -20ºC and 30ºC. Assume compression to be is entropic and no subcooling. In wet compression, vapour leaving the compressor is dry saturated whereas in dry compression, vapour entering the compressor is dry saturated. **[6]**

Sat. Temp. (°C)	h_f (kJ/kgK)	h_g	s_f (kJ/kgK)	s_g
-20	89.8	1420	0.3684	5.6244
30	323.1	1468	1.2037	4.9842

OR

Q4) a) Write a note on 'Total Equivalent Warming Impact'. **[6]**

b) How refrigerants are classified? **[4]**

c) What is the effect of

   i) Increase in evaporator pressure &

   ii) Increase in condensor pressure on cop of VCR cycle? **[6]**

Unit - III

Q5) a) Explain simple vapour absorption refrigeration system with a neat sketch. **[6]**

b) Explain cascade system with the help of p-h diagram. **[6]**

c) Explain two stage compression system with liquid intercooling. **[6]**

OR

Q6) a) Compare : VCR & VAR **[4]**

b) Explain electrolux refrigeration system with a neat sketch. **[6]**

c) What is a multipressure system? Explain multievaporator system with a neat sketch & p-h diagram. Where it is used? **[8]**

SECTION - II
Unit - IV

Q7) a) Write a note on Air Washers. **[6]**

b) Explain adiabatic mixing of two streams. **[4]**

c) Define: i) WBT

           ii) DPT

          iii) Relative humidity

          iv) Specific humidity

          v) Enthalpy of moist air

          vi) Degree of saturation **[6]**

Q8) a) Explain 'comfort chart'. **[6]**

b) What is effective temperature? **[3]**

c) Write a note on evaporative cooling. **[4]**

d) Find specific humidity, relative humidity and enthalpy of moist air if the dry bulb temperature of air is 30ºC while its dew point temperature is 15ºC. **[3]**

Unit - V

Q9) a) Define : i) SHF ii) RSHF iii) ADP **[6]**

b) Explain working of thermostat with a neat sketch. **[6]**

c) Compare unitary air conditioning & central air conditioning system. **[4]**

OR

Q10) a) What is a humidistat? **[3]**

b) Explain working of capillary tube with a neat sketch. **[5]**

c) Explain : i) GSHF ii) ERSHF **[4]**

d) Write a note on 'All Air Conditioning System'. **[4]**

Unit - VI

Q11) a) Write a note on 'Duct Materials'. **[4]**

b) Give applications of cryogenics. **[4]**

c) What are the limitations of VCR system for production of low temperatures. **[4]**

d) Explain any one method used for duct design. **[6]**

OR

Q12) a) Explain linde system with a neat sketch. **[6]**

b) How ducts are classified? **[4]**

c) What is equivalent diameter? **[4]**

d) Explain various losses which take place when air flows through the duct. **[4]**

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[3564] - 137

P1333

B.E. (Mechanical)
ENERGY MANAGEMENT
(2003 Course) (402050) (Elective - II)

Time : 3 Hours]   *[Max. Marks :100*

Instructions to the candidates:

    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)   *Figures to the right indicate full marks.*

    5)   *Use of electronic pocket calculator is allowed.*

    6)   *Assume suitable data, if necessary.*

SECTION - I

Q1) a)   What is meant by non-conventional energy sources? Are all non-conventional energy sources being utilized or worked out in India? What is the future? **[7]**

    b)   What do you think of strategies required for long term management of energy in India? **[7]**

    c)   Classify energy storage systems. **[4]**

OR

Q2) a)   What are the energy conservation opportunities in process industry?**[7]**

    b)   What are the energy consumption patterns of industry, agriculture and residential sectors in India? **[7]**

    c)   Give the details of oil and coal reserves of India. **[4]**

Q3) a)   What is an energy audit? Explain briefly the difference between preliminary and detailed energy audits. **[8]**

    b)   Name and explain anyone measuring instrument for the following parameters. **[8]**

        i)   Air velocity in ducts

        ii)   Oxygen and temperature of the flue gas

        iii)   Hot spots in furnaces

        iv)   Illumination level

OR

Q4) a) What are the advantages and limitations of simple pay back period? **[8]**

b) It is proposed to install a heat recovery equipment in a factory. The capital cost of installing the equipment is Rs. 20,000 and after 5years its salvage value is Rs. 1500. If the savings accrued by the heat recovery device are as shown below, Find out the net present value after 5 years. Discount rate is assumed to be 8%. **[8]**

Year	1	2	3	4	5
	7000	6000	6000	5000	5000

Q5) a) Discuss different factors affecting performance & energy efficiency of refrigeration and air conditioning plants. **[8]**

b) "In case of steam traps, trapping problems are caused by bad installation rather than by the choice of the wrong type or faulty manufacture" Discuss. **[8]**

OR

Q6) a) Discuss various energy efficiency opportunities in boiler system. **[8]**

b) List out factors that affect energy efficiency in air compressor. **[8]**

SECTION - II

Q7) a) A 3 φ AC Load draws 8 kW power at 400 V supply voltage and 15A line current. Calculate the power factor of the load. **[6]**

b) Describe six good practices of energy conservation in lighting system. **[6]**

c) Explain the difference between fans, blowers and compressors. Explain the method of flow measurements using Pitot tube. **[6]**

OR

Q8) a) A tri-vector-meter with half-hour cycle has the following inputs during the maximum demand period.

MD Drawn in kVA	Duration in minutes
100	10
200	5
50	10
150	5

What is the maximum demand during the half-hour interval? **[4]**

b) Describe the functions of the following components of compressed air system: Intake Air Filters, Inter-stage coolers, Air-dryers, Moisture Drain Traps and Receivers. **[6]**

c) What are energy conservation opportunities for a common Indian household? Elaborate with examples and percentage possible savings in energy bills. **[8]**

Q9) a) What is Time of the Day (TOD) tariff? How TOD tariff can be used as a means of DSM? Explain with examples. **[8]**

b) The connected loads for a restaurant are as follows:
   i) 3 fluorescent tubes of 40 W each.
   ii) 4 bulbs of 100 W each.
   iii) It is decided to replace them with 8 CFL of 15 Watts each.

Assuming a tariff of Rs, 4 per kWh, calculate annual energy savings assuming 8 hrs of daily usage. **[8]**

OR

Q10) a) Explain the benefits of insulation. How they are classified? Explain economic thickness of insulation. **[8]**

b) What is cogeneration? How they are classified? Explain anyone type of insulation with the help of schematic sketches. **[8]**

Q11) a) How Refractories are classified? State examples of each type. State briefly the criteria of selection of Refractories. **[8]**

b) Explain Energy Conservation opportunities in thermal power plant. **[8]**

OR

Q12) Write Short Notes on Any Four of the following: **[16]**
   a) Energy Efficient Motors.
   b) Waste heat recovery.
   c) Different heat losses in furnaces.
   d) Energy saving in Refrigerators and air conditioning.
   e) Variable speed drives.
   f) Energy Conservation in pumps.

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P1360

[3564] - 135

B.E. (Mech.)

ROBOTICS (Elective - II)

(402051) (2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:-

    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)   *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

Q1) a)   Define the term "industrial robot" and explain the need of industrial robots.
              [4]

     b)   Explain the physical significance of 4 x 4 homogeneous transformation matrix.   **[4]**

     c)   Sketch and explain various types of joints in manipulator mechanisms.**[8]**

OR

Q2) a)   Explain Denavit-Hartenberg parameters with a suitable example and sketches.   **[6]**

     b)   Compare accuracy with repeatability.   **[4]**

     c)   Sketch and explain 3 DoF associated with wrist.   **[6]**

Q3) a)   An object tracking system identifies a flying object at (800m, 500m, 1500m) in its current co-ordinate system, Which is oriented by 30° of rotation about the X-axis, then 25° of rotation about the Y-axis and finally -35° of rotation about Z-axis of universal co-ordinate system. Map the object in universal co-ordinate system.   **[8]**

b) A camera locates an object by

$$camera\ T\ object = \begin{bmatrix} 0 & -1 & 0 & 50 \\ 1 & 0 & 0 & -75 \\ 0 & 0 & 1 & 20 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

The camera is then translated by 15 units along Z axis of the object, and then rotated about its own X axis by -90°. Determine the new relation between camera and object. **[10]**

OR

Q4) a) What is dexterity? Does it get improved by redundant degree of freedom? Explain. **[6]**

b) A planar 2R manipulator has link lengths 11 = 100 mm and 12 = 70 mm. State and explain whether the manipulator can reach points P, Q, R separately. Where P is at (15,15), Q is at (15,70) and R is at (15,170).**[6]**

c) Explain the geometrical and algebraic approach for inverse kinematic solutions. **[6]**

Q5) a) What are geometric problems in planning a trajectory with Cartesian path? **[6]**

b) A single link robot with a rotary joint is motionless at $\theta = 15°$. It is desired to move that joint in a smooth manner to $\theta = 75°$ in 3 seconds. Find the coefficient of a cubic that accomplishes the motion and brings the manipulator to rest at goal. Plot the position, velocity and acceleration of joint as a function of time. **[10]**

OR

Q6) a) Explain, what is control law partitioning? **[6]**

b) A spring mass damper system has the parameter values m = 2, b = 4, and k = 7. What is the natural response of the system? Determine the gain in the position and velocity controls, so that system will be critically damped with closed loop stiffness as 8. **[10]**

SECTION - II

Q7) a) Discuss a brief classification of grippers. **[4]**

    b) Write a note on RCC devices. **[6]**

    c) Discuss various considerations for selection of a gripper. **[6]**

OR

Q8) a) What are the functions of machine vision systems? **[4]**

    b) Explain vacuum gripper principle with figure and state its applications.**[6]**

    c) State the principle of photoelectric sensors. Explain different types of photoelectric sensors. **[6]**

Q9) a) Discuss the term stiffness with reference to gears. belts and shafts. **[6]**

    b) Explain use of robot in are welding operations. **[6]**

    c) Discuss three phases in the robot design procedure. **[6]**

OR

Q10) a) Explain use of robot in plastic moulding operations. **[6]**

    b) Explain the working of strain gauge as a force sensor. **[6]**

    c) Discuss the general considerations in robot material handling. **[6]**

Q11) a) Discuss various characteristics of actuators in robots. **[4]**

    b) Explain generations of robot programming languages. **[6]**

    c) Write a note on DC servomotor. **[6]**

OR

Q12) a) Explain manual mode of programming in robot. **[4]**

    b) Compare hydraulic and electrical actuators in robots. **[6]**

    c) State various robot languages. Discuss them in brief. **[6]**

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P1298

[3564]-141

B.E. (Mech. S/W) (Semester - I)
DESIGN ENGINEERING
(2003 Course)

Time : 4 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) *Answer three questions from Section I and three questions from Section II.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

SECTION - I

Q1) a) Explain with neat sketches, mountings used in bevel gear pairs. **[6]**

   b) A triple start worm rotating at 1440 r.p.m transmits 5 kW power to a worm gear rotating at 72 r.p.m. The pitch circle diameter of worm is 60 mm and axial module is 6 mm. The tooth system is 20º stub-involute, while the coefficient of friction between worm and worm gear tooth is 0.1. If the worm is left hand type, determine **[10]**
   i) The components of tooth force acting on the worm and worm gear.
   ii) The efficiency of worm gear pair.

<div align="center">OR</div>

Q2) a) Explain the thermal conditions used in design of worm gear drive. **[6]**

   b) A pair of straight bevel gears, manufactured by cutting, consists of a 18 teeth pinion rotating at 1500 r.p.m meshing with a bevel gear rotating at 600 r.p.m. The axis of pinion and gear interseat at right angles. The module is 4 mm, while the face width is 35 mm. The tooth system is 20º full depth involute. The gear pair is made of plain carbon steel 55C8 (Sut = 720 N/mm^2) and is heat treated to a surface hardness of 400 BHN. The service factor and factor of safety are 1.75 and 1.5 respectively. Assuming the suitable expression for velocity factor and considering the velocity factor accounts for the dynamic load, determine, **[10]**
   i) The beam strength.
   ii) The wear strength.

iii) The maximum static load that the gear pair can transmit.

iv) The rated power that the gear pair can transmit.

Use the data given below.

Lewis Form Factor (Y')

No.of teeth	17	18	19	20	21	75	100	150	300
Y'	0.3016	0.3079	0.3142	0.3204	0.3267	0.4335	0.4461	0.4587	0.4712

Q3) a) Write a short note on corrosion allowance. **[4]**

b) Derive Lame's equation. State under what condition it is used. **[6]**

c) Write a note on 'support for pressure vessels'. **[6]**

OR

Q4) a) Explain the class of vessels based on IS 2825. **[6]**

b) The cylindrical pressure vessel shell of internal diameter 3 m and length 6 m is subjected to an operating pressure of 0.75 MPa. Torispherical heads each with a crown radius of 2.25 m, are used as end closures. The shell as well as heads are made of plain carbon steel with yield strength of 225 N/mm². Double welded butt joints which are spot radiographed are used to fabricate the vessel. The severe operating conditions demand the corrosion allowance of 3 mm, determine **[10]**

i) The thickness of the cylindrical shell.

ii) The thickness of the torispherical head.

iii) The storage capacity of the pressure vessel.

Q5) a) What is Design for Assembly? Explain the general principles to be followed while designing the parts for assembly. **[8]**

b) A shaft is subjected to a maximum load of 10 kN. The shaft is designed to withstand a load of 15 kN. If the maximum load encountered is normally distributed with a standard deviation of 2.5 kN, and if the shaft strength is normally distributed with standard deviation of 2 kN, what failure percentage would be expected? **[10]**

The area under normal curve from zero to Z is as follows.

Z	1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8
Area	0.3413	0.3849	0.4192	0.4452	0.4641	0.4772	0.4861	0.4918	0.4953	0.4974

Q6) a) What are the statistical considerations for factor of safety. **[4]**

b) What is mechanical reliability? Explain the following terms. **[6]**

   i) Hazard rate.
   ii) MTBF.

c) Describe principles of design of forgings. **[8]**

SECTION - II

Q7) a) Explain various factors affecting fatigue strength of a machine component, subjected to fluctuating loads. **[4]**

b) A transmission shaft supports a pulley midway between the two bearings. The bending moment at the mid point varies from 200 N.m to 600 N.m. The torque on the shaft varies from 70 N.m to 200 N.m. The frequencies of variation of bending moment and torque are equal to the shaft speed. The shaft rotates at 1440 r.p.m. The shaft is made of plain carbon steel with ultimate tensile strength of 540 N/mm² and yield strength of 400 N/mm². The corrected endurance limit of the shaft is 200 N/mm². If the factor of safety is 2, determine the diameter of the shaft. **[12]**

OR

Q8) a) Explain cumulative fatigue damage. **[4]**

b) A helical compression spring made of oil hardened and tempered steel wire (Sut = 1300 N/mm² and G = 81500 N/mm²) is to be used in the exhaust valve mechanism of diesel engine. The operating force on the spring varies continuously between 200 N and 500 N. The maximum valve lift is 21.5 mm. If the required factor of safety is 1.5, determine

   i) The spring wire diameter.
   ii) The main coil diameter.
   iii) The number of active coils.

   The spring index can be assumed as 8. **[12]**

Q9) a) What is adequate design? **[4]**

b) A simple tensile bar is subjected to the specified constant tensile force 'F'. Design the bar with the objective of minimizing the material cost, using the factor of safety 'N_f'. The following limitations are specified in the optimum design :

   $$L_{min} \le L \le L_{max}$$
   $$A_{min} \le A$$ **[12]**

Q10) a) What the objectives of optimum design. **[4]**

b) What do you mean by the case of redundant and incompatible specifications? **[4]**

c) Explain Johnson's method of optimum design, with reference to any one example. **[8]**

Q11) a) What are the considers in the design of controls? **[6]**

b) Explain in brief the system concept for material handling. **[6]**

c) Explain with neat sketches any two different types of belt idlers. **[6]**

OR

Q12) a) Explain with neat sketches, the various aesthetic considerations used in the design of products. **[6]**

b) Write a note on 'work place environment and its influence on the man machine cycle'. **[6]**

c) What the basic objectives of a material handling system? **[6]**

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P1198

[3564] - 145
B.E. (Mechanical S/W)
TRIBOLOGY
(2003 Course) (402063)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:-

    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)   *Figures to the right indicate full marks.*

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

    6)   *Assume suitable data, if necessary.*

SECTION - I
Unit - I

Q1) a)   What is the effect of pressure and temperature on viscosity of oil? Discuss in brief.   **[6]**

     b)   State physical and chemical properties of Lubricants.   **[4]**

     c)   Explain in detail the methods of recycling of used oil.   **[6]**

OR

Q2) a)   Explain basic modes of Lubrication.   **[8]**

     b)   What is role of additives? Explain in detail EP additives.   **[6]**

     c)   Explain SAE classification of lubricating oils.   **[2]**

Unit - II

Q3) a)   Derive Archard's equation for volume of adhesive wear with assumptions made. State Laws of wear using above equation.   **[8]**

     b)   Explain Ferrography technique for measurement of wear.   **[4]**

     c)   Enumerate the factors affecting wear.   **[4]**

OR

Q4) a) What is mean by :   [6]
  i)   Contact area/contour area of contact.
  ii) Real area of contact.
  iii) Apparent area of contact.

b) Explain the following theories of friction :   [6]
  i)   Coulomb's classical theory of interlocking.
  ii) Tomlinson's theory of molecular attraction.

c) Explain stick-slip oscillations.   [4]

Unit - III

Q5) a) Derive the Renold's equation -   [12]

$$\frac{\partial}{\partial x}\left[h^3\frac{\partial p}{\partial x}\right]+\frac{\partial}{\partial y}\left[h^3\frac{\partial p}{\partial x}\right]=-6\mu\, U\frac{\partial h}{\partial x}$$

With usual notations. State the assumptions made in the equation.

b) Explain Boyd-Raimondi's method for analysis of Hydrodynamic Journal Bearing.   [6]

OR

Q6) a) Derive an expression for pressure 'p' around a short journal bearing of

length L as $p = \dfrac{3U\eta C\varepsilon\sin\theta}{RC^3(1+\varepsilon\cos\theta)^3}\left[\dfrac{L^2}{4}-y^2\right]$ with usual notations.   [10]

b) Following data is given for a 360° Journal bearing :   [8]
  Journal diameter = 50 mm
  Bearing Length = 50 mm
  Radial load = 3.2 kN
  Journal Speed = 1490 rpm
  Radial Clearance = 0.05 mm
  Oil viscosity = 25 cP
  Assuming that the total heat generated in the bearing is carried away by the total oil flow in the bearing, calculate
  i)   Minimum oil film thickness,
  ii) The coefficient of friction,
  iii) Flow requirement in litre/min and
  iv) Power lost in friction.

$\left(\dfrac{l}{d}\right)$	ε	$\left(\dfrac{h_o}{c}\right)$	S	ϕ	$\left(\dfrac{r}{c}\right)f$	$\left(\dfrac{Q}{rcn_s l}\right)$	$\left(\dfrac{Q_s}{Q}\right)$	$\left(\dfrac{p}{p_{max}}\right)$
1	0	1.0	∞	(85)	∞	π	0	—
	0.1	0.9	1.33	79.5	26.4	3.37	0.150	0.540
	0.2	0.8	0.631	74.02	12.8	3.59	0.280	0.529
	0.4	0.6	0.264	63.10	5.79	3.99	0.497	0.484
	0.6	0.4	0.121	50.58	3.22	4.33	0.680	0.415
	0.8	0.2	0.0446	36.24	1.70	4.62	0.842	0.313
	0.9	0.1	0.0188	26.45	1.05	4.74	0.919	0.247
	0.97	0.03	0.00474	15.47	0.514	4.82	0.973	0.152
	1.0	0	0	0	0	0	1.0	—

Table 1 : Dimensionless Performance Parameters for full journal bearings with side flow

SECTION - II
Unit - IV

Q7) a) Derive relation for flow rate of lubricating oil and pressure distribution for a Circular step bearing with neat sketch. **[10]**

b) Two reservoirs are connected by a slot 20 cm wide, 0.3 mm thick and 30 cm long. The reservoirs are filled with oil of 105cP. The pressure in the two reservoirs are 10 bar and 3 bar respectively. Determine the quantity of oil flowing and average velocity of oil. Assume relative density of 0.8. **[6]**

OR

Q8) a) Discuss different types of energy losses in hydrostatic bearings & derive an equation for the same. **[7]**

b) The hydrostatic step bearing consists of six pads as shown. Neglecting the flow over corners of each pad can be approximated as a circular area of outer and inner diameter of 500 mm and 200 mm resp. The total thrust load is 900 kN and the film thickness is 0.15 mm. The viscosity and density of the oil are 30 cP and 0.9 gm/cc resp. The specific heat of the lubricant is 2.09 kJ/kg °C. If the shaft is rotating at 720 rpm, calculate **[9]**
   i) Supply pressure
   ii) Lubricant flow rate
   iii) Frictional power loss
   iv) Pumping power loss and
   v) Temperature rise.

Single pad
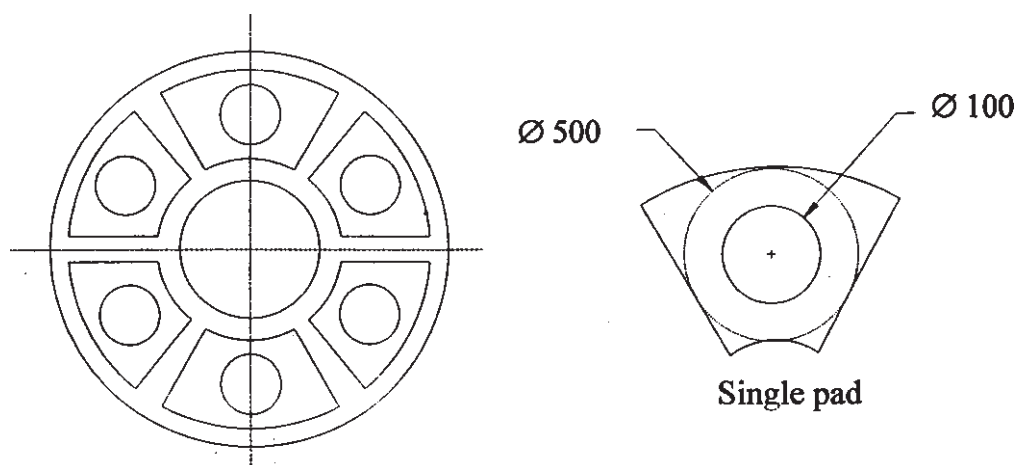
Unit - V

Q9) a) Derive equations for maximum pressure distribution & load carrying capacity for a rectangular plate near a plane under hydrostatic squeeze film lubrication. **[10]**

b) Explain merits, demerits and applications of Gas bearings. **[6]**

OR

Q10) a) Explain the mechanism of squeeze film lubrication. Where does it occur? **[8]**

b) A plate of 25 mm length and infinite width is separated from the plane by an oil film of 25 μm. Thickness and having viscosity of 0.05 Ns/m². If a normal load of 20 kN per unit width is applied on the plate, Determine

i) The time required to reduce the film thickness to 2.5 μm.

ii) Maximum pressure. **[8]**

Unit - VI

Q11) a) Show that in an infinite width tapered bearing of length L, the pressure is maximum at a distance of $\dfrac{nL}{(n+1)}$ from the leading edge. **[10]**

b) The plane tapered pad bearing having length of 100 mm and width of 300 mm is to be used to support a load of 20 kN. The sliding velocity is 4 m/s. The sum of surface roughness on mating surface is 10 microns. The oil film thickness should not to be less than 6 times the sum of surface roughness on mating surfaces. If the side leakage is prevented, calculate: **[8]**

i)   The viscosity of the lubricating oil;
ii) The angle of inclination of fixed surface; and
iii) The distance of point of application of load from the leading edge.

<div align="center">OR</div>

*Q12)*a) Explain in detail commonly used materials for sliding contact bearings. **[10]**

b) Explain desirable properties of bearing materials. **[8]**

<div align="center">■■■■</div>

P1126

[3564] - 149
B.E. (Mechanical S/W)
COSTING & COST CONTROL
(2003 Course)

Time : 3 Hours]   *[Max. Marks:100*
Instructions to the candidates:

   1)   *Answer 3 questions from each section.*

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

   3)   *Assume suitable data, if necessary.*

SECTION - I
UNIT - I

Q1) a)   Explain elements of costs.   **[8]**

      b)   The market price of a lathe is Rs. 5000 and the discount allowed to the distributer is 20% of the market price. It is found that the selling expense cost is $1/4^{th}$ the factory cost and if the material cost, labour cost and factory overhead charges are in the ratio of 1:4:2; what profit is made by the factory on each lathe, if material cost is Rs. 400? Neglect other overheads.   **[8]**

      c)   Define Profitability.   **[2]**

OR

Q2) a)   Explain various components of cost.   **[8]**

      b)   List & explain the sources which increase the cost of product. And which factors should be use to reduce the cost of product.   **[10]**

UNIT - II

Q3) a)   Explain Depreciation and give its classification.   **[6]**

      b)   Provide examples for each of the following
         i) Direct labour ii) Indirect labour iii) Direct materials iv) Indirect materials v) Indirect expenses.   **[10]**

OR

Q4) a) Explain the meaning of the terms - Prime cost, Overheads cost, Cost allocations. **[8]**

b) Explain controllable and uncontrollable cost. **[8]**

UNIT - III

Q5) a) From the records of a manufacturing company, the following budgeted details are available. **[12]**

	Rs.	Rs.
Direct material	1,99,000	
Direct Wages		
Machine shop (12,000 hours)	63,000	
Assembly shop (10,000 hours)	48,000	1,11,000

Works Overheads		
Machine shop	88,200	
Assembly shop	51,800	1,40,000

Administrative Overheads		90,000
Selling Overheads		81,000
Distribution Overheads		62,100

Assuming that the company follows absorption method of costing, you are required to:

i) Prepare a schedule of overhead rate from the figures available stating the basis of overhead recovery rates used under the given circumstances.

ii) Work out the cost estimate for the following jobs based on the overheads so computed.

Direct material — -25 kgs at Rs. 16.80/kg
— -15 kgs at Rs. 20.00/kg

Direct labour — Machine shop 30 hours.
(On the basis of hourly - Assembly shop 42 hours rate for Machine shop and Assembly shop.

b) Explain Process Costing. **[4]**

OR

Q6) a) The budgeted working condition of a cost center are as follows.

Normal working per week	- 42 hours
No. of machines	-14
Normal weekly loss of hours on maintenance etc.	- 5 hours per machine
No of weeks worked per year	- 48
Estimated annual overheads	- Rs. 1,24,320
Estimated direct wage rate	- Rs. 4 per hour.

Actual result in respect of a 4 week period are:

Wages incurred	- Rs. 9,000
Overheads incurred	- Rs. 10,200
Machine hours produced	- 2,000

You are required to calculate: i) The overhead rate per machine hour ii) The amount of under or overabsorption of wages and overheads. **[10]**

b) Why are budgeted overhead rates preferred to actual overhead rates.**[6]**

SECTION - II
UNIT - IV

Q7) a) Explain in brief Batch Costing. List four types of industries which use this method. **[8]**

b) Describe the four different methods of allocating joint stocks to products. **[8]**

c) Define future processing costs. **[2]**

OR

Q8) a) Explain why it is necessary to allocate joint cost to products. **[8]**

b) Distinguish between By-products, waste and scrap. **[6]**

c) Describe the accounting treatment of By-products. **[4]**

UNIT - V

Q9) a) Give examples of how cost-volume profit analysis can be used for decision making. **[8]**

b) You are give the following data for the year 1990 of a company :

	Rs.	%
Variable costs	6,00,000	60
Fixed costs	3,00,000	30
Net profit	1,00,000	10

Sales	10,00,000	100

Find out break-even point, P/V ratio and margin of safety ration. also draw a break-even chart indicating the marginal contribution. **[8]**

OR

Q10) a) With the help of diagram explain Break-even point concept with the help of diagram. **[8]**

b) Alpha company budgeted for the year 1992, sales Rs. 5,00,000 (selling price being Rs. 20 per unit). fixed cost Rs. 1,80,000 and variable costs Rs. 2,60,000. Find out break-even point i) taking into consideration the budgeted figure and ii) assuming 20% increase in fixed costs. Also draw break-even chart. **[8]**

UNIT - VI

Q11) Write short note on : **[16]**

a) Marginal costing.

b) Activity based costing.

OR

Q12) a) Explain how a standard costing system operates. **[8]**

b) Explain Activity based costing. **[8]**

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P1099

[3564]-125

B.E. (Mechanical Engg.)

GAS TURBINES AND JET PROPULSION

(2003 Course) (402044)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

    1)   *Answer three questions from section-I and three questions from section-II.*

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

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

    4)   *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

Q1) a) Derive the condition for maximum discharge through nozzle and critical pressure ratio. **[7]**

    b) Define acoustic velocity and derive the relation for acoustic velocity in terms of absolute temp. and adiabatic index. **[5]**

    c) What is static and stagnation values? Classify the types of flows as per the value of Mach number. **[4]**

OR

Q2) a) A nozzle in a wind tunnel gives a test section Mach number is 2, with a throat section $1000cm^2$ in area. The supply pressure and temperature at the nozzle inlet, where the velocity is negligible are 0.69 bar and 310 K respectively. The preliminary design is to be based on the assumptions that the flow is isentropic, with $\gamma = 1.4$ and that the flow is one dimensional at the throat and test section. Determine

    i)   Pressure, temperature, velocities at throat and test section.

    ii)   Area of cross section of the test section.

    iii)   Mass flow rate.

    iv)   Power required to drive the compressor.

M	T^*/T_0	P^*/P_0	M	T_2/T_0	P_2/P_0
1	0.834	0.528	2	0.555	0.128

[12]

b) Write a short note on Rayleigh flow and Rayleigh line. **[4]**

Unit - II

Q3) a) Represent the centrifugal compressor cycle on h-s diagram and explain the various processes involved. **[6]**

b) In an axial flow compressor, the overall stagnation pressure ratio achieved is 4 with overall stagnation isentropic efficiency 300K. The mean blade speed is 180 m/s. The degree of reaction is 0.5 at the mean radius with relative air angles of 120 and 320 at the rotor inlet and outlet respectively the work done factor is 0.9. Calculate : **[10]**

i) Stagnation polytropic efficiency.
ii) Number of stages.
iii) Inlet temp.and pr.
iv) Blade height in the first stage if the hub tip ratio is 0.42, mass flow rate 19.5kg/s.

OR

Q4) a) Derive an expression for work input to an axial flow compressor. What do you understand by work done factor? Derive relation for the same.**[8]**

b) What do you mean by slip and slip factor? Why diffusers are necessary in a centrifugal compressor? **[8]**

Unit - III

Q5) a) Describe with neat sketches the working of constant pressure combustion gas turbine cycles. **[8]**

b) Air is drawn in a gas turbine unit at 15°C and 1.01 bar and pressure ratio is 7:1. The compressor is driven by the H.P. turbine and L.P. turbine drives a separate power shaft. The isentropic efficiencies of compressor, H.P. and L.P. turbines are 0.82, 0.85 and 0.85 respectively. If the maximum cycle temperature is 610°C, calculate :

i) The pressure and temperature of the gases entering the power turbine.
ii) The net power developed by the unit per kg/s mass flow.
iii) The work ratio.
iv) The thermal efficiency of the unit.

Neglect the mass of fuel and assume the following :

For compression process Cp_a = 1.005 kJ/kgK and γ = 1.4.

For combustion and expansion processes; Cp_g = 1.15kJ/kgK and γ = 1.33. **[10]**

OR

Q6) a) Write a short note on fuels used for gas turbine. **[7]**

b) Discuss the advantages and disadvantages of gas turbine over steam turbine and petrol and diesel engines. **[6]**

c) Derive the relation for the thermal efficiency of ideal Brayton cycle. **[5]**

SECTION - II

Unit - IV

Q7) a) Explain what do you understand by pressure compounding of a multistage impulse turbine. **[5]**

b) With the help of h-s diagram, prove that internal efficiency of a multistage machine is product of stage efficiency and reheat factor. **[6]**

c) For a fifty percent reaction turbine, prove that maximum work is V_b^2, where V_b is the mean blade speed. **[7]**

OR

Q8) a) How gas turbines are classified? **[6]**

b) In a single stage impulse turbine, the nozzle discharges the hot gas on to the blades at a velocity of 750m/s. The mass flow rate of gas 100kg/s. The turbine rotates at 20000rpm. The mean diameter of wheel is 31.5cm. The nozzles are inclined at an angle of 20°. to the plane of wheel rotation. Calculate : **[12]**

i) Power developed by the blades in MW,

ii) Energy lost in the blades in MW and

iii) Blade efficiency of the turbine.

Assume blade friction coefficient as 0.92 and outlet blade angle as 25° to the plane of rotation.

Unit - V

Q9) a) What are the requirements of a gas turbine combustion chamber? **[6]**

b) Define combustion efficiency and combustion intensity. **[6]**

c) What is mixing and dilution? **[4]**

OR

Q10) Write short notes on : **[16]**

a) Requirements for high temperature materials.

b) Combustion Chamber arragement.

c) Pollution in Combustion Chamber.

d) Factors influencing selection of materials.

Unit - VI

Q11) a) Explain the working of Ramjet Engine by means of a sketch. What are its advantages, disadvantages and applications? **[5]**

b) A jet propelled engine having two jets and working on turbojet has a velocity of 210m/s, when flying at an altitude of 12000m, the density of air at this altitude 0.172kg/m³. the resistance or drag of the plane is 6670.8N and propulsion efficiency of the jet is 50%. Calculate :

   i)   Absolute velocity of the jet.
   ii) Quantity of air compressed/minute.
   iii) Diameter of the jet.
   iv) Net output of gas turbine plant.
   v)   TSFC.
   vi) Air-fuel ratio.

   Take $\eta_{overall}$ = 18%, CV = 4.895 × 10⁴kJ/kg. **[11]**

OR

Q12) Write short notes on : **[16]**

   a) Scram Jet Engine.
   b) Turbo fan Engine.
   c) Turbo prop Engine.

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P1096

[3564]-122

B.E. (Mechanical)

MECHANICAL SYSTEM DESIGN

(2003 Course)

Time : 4 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

   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

Q1) a) Draw stress distribution in a compound cylinder and explain how it helps to increase the pressure capacity of a cylinder of same total thickness.**[6]**

    b) State different theories of failure used in the design of thick cylinders subjected to internal pressure and their applicability under different situations.   **[6]**

    c) An open ended hydraulic cylinder made of plain carbon steel 15C8 (Sut = 440 N/mm², Syt = 240 N/mm²) with 220 mm inside diameter is subjected to internal pressure of 18 MPa. Using appropriate theory of failure, find the required thickness of cylinder with a factor of safety 2 Assume Poisson's ratio of cylinder material = 0.29.   **[6]**

OR

Q2) a) What are the objectives of prestressing the high pressure cylinders? Name the various methods of prestressing such cylinders.   **[3]**

    b) A steel tube, with inner and outer diameters of 50 mm and 75 mm respectively is reinforced by shrinking a steel jacket of outer diameter 100 mm. The outer diameter of inner tube has the tolerance of $^{+0.059}_{+0.043}$ mm , while the inner diameter of jacket has the tolerance of $^{+0.025}_{+0.000}$ mm .

       i)   Find the circumferential stress range of the tubes at the interface.

ii) If the coefficient of thermal expansion is $1.15 \times 10^{-5}/°C$, calculate by what temperature the outer jacket should be heated to achieve the shrink fit.

Take $E = 207 \times 10^3$ N/mm² **[15]**

Q3) a) Explain the terms giving examples.

    i) Coefficient of fluctuation of speed.

    ii) Maximum fluctuation of energy.

    iii) Rimmed flywheel. **[6]**

b) The T - θ diagram of a diesel engine consists of intercepted areas which are + 40, – 85, + 79, – 68, + 96 and – 62 mm² in one cycle taken in the given order. The torque axis scale is 1 mm = 75 Nm and crank angle scale is 1 mm = 5°. Mean speed of the engine is 500 rpm. Design the rim of the flywheel for the following data.

    i) Limiting rim speed at mean radius = 30 m/s.

    ii) The fluctuation of speed = 2% around mean speed.

    iii) Width to thickness ratio for rectangular rim section is 1.5 which contributes 100% MI of flywheel.

    iv) Material density 7200 kg/m³ Neglect the flywheel effect of hub and arms. **[10]**

OR

Q4) The torque developed by engine & the load torque of the m/c are given by following expression

$T_e = 10,000 + 5000 \sin 2\theta$ (Nm)

$T_m = 10,000 + 5000 \cos 2\theta$ (Nm)

Where θ is crank angle.

The maximum and minimum speed of the flywheel during the cycle is 245 & 235 rpm respectively. Rim contributes 90% of the required moment of inertia of flywheel. The cross section of the rim is rectangle with width to thickness ratio of 2.

Design the rimmed flywheel made of Gray CI FG 200 for the following data

Mass density of rim = 7200 kg/m³

Limiting mean rim velocity = 21 m/s.

Factor of safety = 7.5

Radius of flywheel hub = 80mm

Also find the power delivered by the engine. **[16]**

Q5) a) Explain clearly mechanical reliability and factor of safety. **[4]**

b) The recommended class of transition fit between the recesses and the spigot of a rigid coupling is 60 H_6–j_5. Assuming that the dimensions of the two components are normally distributed and that the specified tolerance is equal to the natural tolerance, determine the probability of interference fit between the two components. The tolerances in microns are as below.

Diameter	H_6	j_5
60	+19	+06
	−00	−07

For area under standard normal distribution curve, use values from table below. **[12]**

Z	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
Area	0.3413	0.3849	0.4192	0.4452	0.4641	0.4772	0.4861	0.4912	0.4953	0.4974	0.4980

OR

Q6) a) Explain design tolerance and natural tolerance. **[6]**

b) A tension rod is subjected to axial stress within elastic limit. The strain in rod is normally distributed variable with a mean of 0.001 mm/mm and a standard deviation of 0.00007 mm/mm. The modulus of elasticity is also normally distributed with a mean of 2.07×10^5 N/mm² and a standard deviation of 6000 N/mm².

Determine the mean and standard deviation of the corresponding stress variable σ. Assume material to be steel. Comment on the analysis. **[10]**

SECTION - II

Q7) a) Draw the structure and speed diagram for a gear box having operating speed range from 56 rpm to 1000 rpm. Use R4 series, with standard spindle speeds. The gear box is connected to a motor driven by a pair of pulleys. Assume the motor speed to be 1440 rpm. Draw the gear box layout diagram. **[12]**

b) Explain the significance of the term "Geometric progression ratio", in the design of multispeed gear box. **[6]**

OR

Q8) a) What is structural formula? Differentiate between the ray diagram with respect to a structural formula and the speed ray diagram for the same. Explain with a suitable example. **[6]**

b) The headstock gear box of a turret lathe requires nine spindle speeds for the main spindle ranging from 1000 rpm to 30 rpm. Draw any one speed diagram indicating the speeds on the speed ray diagram and draw the corresponding layout of the gears in the gear box. **[12]**

Q9) a) Explain Johnson's methodology of optimum design. **[4]**

b) A simple tension bar having circular cross section is subjected to a tensile force P. Design the bar with the objective of minimizing the material cost, using factor of safety N. The following limitations are specified in the optimum design. Assume suitable notations.

$$L_{min} \leq L \leq L_{max}$$
$$A_{min} \leq A$$ **[12]**

OR

Q10) a) A thin spherical pressure vessel is subjected to an internal pressure of 4 N/mm². The mass of the empty vessel should not exceed 125 kg. If the factor of safety is 3.0, design the pressure vessel with the objective of maximizing the gas storage capacity, out of the following materials. **[12]**

Material	Ultimate tensile strength Sut $\dfrac{N}{mm^2}$	Mass density ρ kg/m³
M_1	500 N/mm²	7800 kg/m³
M_2	250 N/mm²	2800 kg/m³
M_3	420 N/mm²	8400 kg/m³

b) What is design for manufacture? Explain the general principles to be followed while designing the parts for manufacture. **[4]**

Q11) a) A 3 idler, troughed belt horizontal conveyor is to be used for transporting 2640 ton/day of mineral ore having specific gravity of 1.2. The surcharge factor 'C' for the 3 idler troughed belt is 0.15. If the belt speed is 3.6 km/hr. Select the standard belt width for the conveyor belt. Assume density of water is equal to 1000 kg/m³ at 24ºC.

The available standard belt widths are 400, 450, 500, 600, 650, 750, 800, 900, 1000, 1200, 1400, 1600, 1800, 2000 mm. **[10]**

b) Explain with neat sketches, the different types of hoisting equipment. **[6]**

Q12) a) State and explain the requirements of good conveyor belt. **[4]**

b) Determine the resistance offered by a single carrying and return idler for the conveyor having following data.

Capacity of the conveyor = 500 tph.

Belt speed = 2 m/s.

Mass of belt = 18 kg/m.

Mass of each idler = 25 kg.

Carrying side pitch = 1 m.

Return side pitch = 2 m.

Coefficient of friction between the idler & the pulley = 0.02.

Coefficient of friction between the roller pin & the idler = 0.04.

Ratio of roller pin diameter to idler tube diameter = 0.5.

Belt inclination = 25°. **[12]**

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B.E. (Mech./SW)

INDUSTRIAL ENGINEERING

(402065) (2003 Course) (Elective - III)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *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

Q1) a) Define & explain briefly the term 'Industrial Engineering'. Mention the contribution made by Frank Gilbreth to the field of IE. **[7]**

b) What is Method Study? Discuss in brief the various steps involved in method study. **[9]**

OR

a) Discuss in brief various recording techniques/charts used in method study. **[8]**

b) What are Therbligs? Give any eight Therbligs with symbols. **[8]**

Q2) a) Discuss in brief the steps involved in Time study. **[10]**

b) The following data refers to a sampling study of production of one part.

i) Duration of data collection = 05 days @ 08 hours per day.

ii) No. of operators = 10

iii) Allowances given for the process = 05%

iv) Production quantity in 5 days = 6000 pieces.

v) Sampling data collected = As per given in table.

Days	1	2	3	4	5
No. of observations	230	240	200	180	225
Occurance of activity (working)	200	190	170	150	210

Calculate standard time of production of part if average performance rating of the operator is 120% and the entire operation is manual. **[8]**

OR

a) Define work measurement. Mention any four uses of work measurement data. **[5]**

b) Write short notes on - **[8]**

   i) PMTS.

   ii) MOST.

c) An industrial operation consists of five elements with following observed times and the performance ratings.

Element	Observed time (min)	PR%
A	0.20	85
B	0.08	80
C	0.50	90
D	0.12	85
E	0.10	80

Assuming rest & personal allowances as 15% and contingency allowance as 2%, calculate the standard time per piece. **[5]**

Q3) a) What is Man-Machine system? Explain with any suitable example. **[6]**

b) Write short notes on - **[10]**

   i) Application of Ergonomics.

   ii) Anthropometry.

OR

a) Explain the principles of work place design. Also state the parameters to be considered for work place design. **[8]**

b) Describe the various factors which causes stresses for an operator. **[8]**

SECTION - II

Q4) a) 'Mere increase in production may or maynot contribute to increase in productivity'.- Comment. Also define productivity. **[6]**

b) 'Mathematics of OR is a mathematics of optimisation' - Discuss. **[5]**

c) Mention all the changes required for converting any primal L.P.P. to its dual. **[5]**

OR

a) An advertising company wishes to plan its advertising strategy in three different media - television, radio and magazines. The purpose of advertising is to reach as large a number of potential customers as possible. Following data have been obtained from market survey.

	TV	Radio	Magazine I	Magazine II
Cost of an advertising unit	Rs. 30,000	Rs. 20,000	Rs. 15,000	Rs. 10,000
No. of potential customers reached per unit.	2,00,000	6,00,000	1,50,000	1,00,000
No. of female customers reached per unit	1,50,000	4,00,000	70,000	50,000

The company wants to spend not more than Rs. 4,50,000 on advertising. Following are the further requirements that must be met.

i) Atleast 1 million exposures takes place among female customers.

ii) Advertising on magazines be limited to Rs. 1,50,000.

iii) At least three advertising units be bought on magazine I and 2 units on magazine II and

iv) The number of advertising units on TV & Radio should each be between 5 & 10.

Formulate an L.P. model for the problem. Do not solve further. **[5]**

b) Solve - $Z_{max} = 100x_1 + 60x_2 + 40x_3$

S.t. $x_1 + x_2 + x_3 \leq 100$

$10x_1 + 4x_2 + 5x_3 \leq 600$

$2x_1 + 2x_2 + 6x_3 \leq 300$ & $x_1, x_2, x_3 \geq 0.$ **[11]**

Q5) a) Describe the quantitative methods available for deciding the plant location. **[6]**

b) What are the principles of plant layout? **[7]**

c) What are the principles of material handling. Mention any five. **[5]**

OR

a) Discuss in brief the various types of plant layouts. **[5]**

b) Discuss the concpet & types of automated storage / retrieval systems. **[7]**

c) Mention the relationship between plant layout & material handling. **[4]**

d) Define 'Equipment utilisation Ratio'. **[2]**

Q6) a) Explain 'Q' system & 'P' system of inventory management. **[4]**

  b) Write a short note on :

  i) Disaggregation of Aggregate Plan.

  ii) Master Production schedule **[12]**

<div align="center">OR</div>

Write short notes on - **[16]**

a) MRP I & II.

b) Job sequencing.

c) JIT.

d) Production scheduling.

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P1106   **[3564] - 139**

B.E. (Mechanical)

RELIABILITY ENGINEERING (Elective - II)

(2003 Course) (402050)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

1)   Answer three questions from each section.

2)   Attempt Q1 or Q2, Q3 or Q4, Q5 or Q6 from Section I.

3)   Attempt Q7 or Q8, Q9 or Q10, Q11 or Q12 from Section II.

4)   Neat diagrams must be drawn wherever necessary.

5)   Assume suitable data, if necessary.

6)   Figures to the right indicate full marks.

7)   Use of non-programmable electronic calculators is allowed.

SECTION - I

Q1) a)   Following table shows the results of life tests carried out on 200 components simultaneously for 100 hours.   **[10]**

Operating Time (hours)	0	10	20	30	40	50	60	70	80	90	100
Number of surviving Components	200	180	160	145	130	105	96	80	72	66	50

Evaluate hazard rate, failure density and reliability and plot these functions against time.

   b)   What is meant by Availability? Explain types of availability of the system.

[8]

OR

Q2) a)   Calculate the reliability of the system shown in Fig. 1. The values show the reliability of individual components in the system.   **[10]**
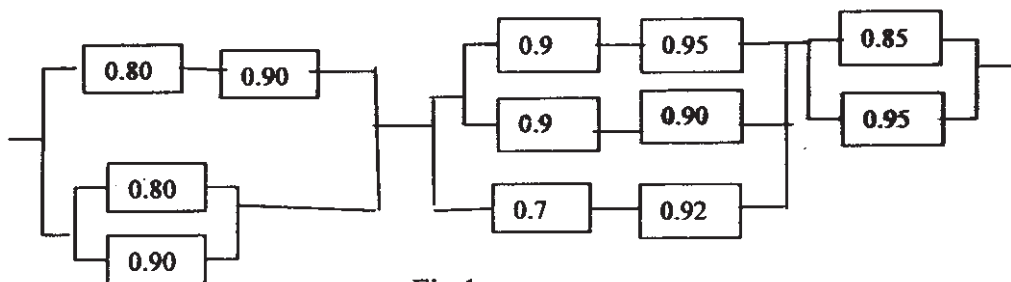

Fig.1

b) State and Explain Total Probability Theorem. **[8]**

A thermal power plant buys four boilers. If there is a 50 percent chance that each boiler works for a year without any breakdown find the probability of realizing at least three boilers in operating condition after one year.

Q3) a) Find the reliability of the system shown in Fig. 2. The values show the reliability of individual components in the system. **[8]**
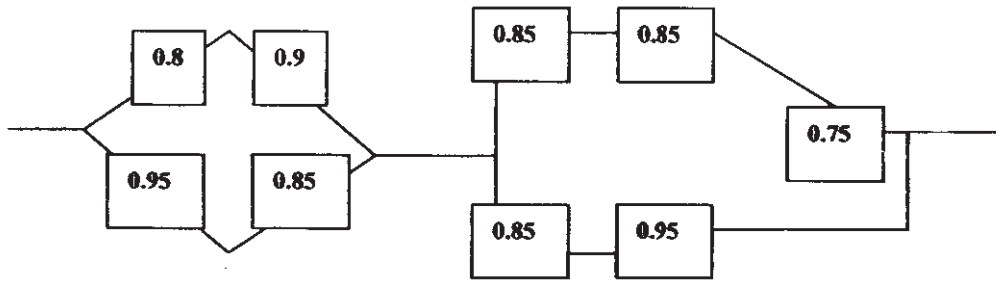
Fig.2

b) Show that MTTF for n components in series is given by

$$MTTF = \frac{1}{\sum\limits_{i=1}^{n} \lambda_i} .$$ **[8]**

OR

Q4) a) State the probability distributions in reliability evaluation. Explain any two. **[8]**

b) State and explain central limit theorem with suitable example. **[8]**

Q5) a) Calculate the reliability of the system shown in Fig. 3. The values in the block show the reliability of individual components in the system. **[8]**
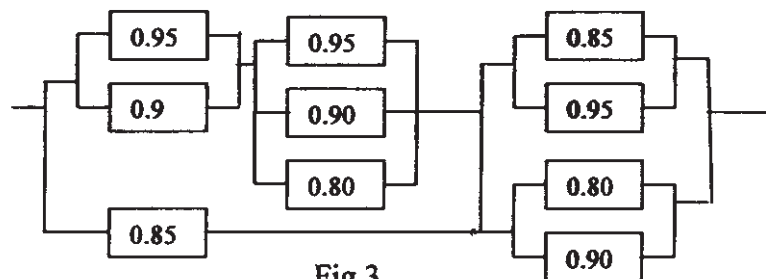
Fig.3

b) A system consists of 5 sub-systems in series. The system reliability goal is 0.994 for 20 hours mission-time. Each sub-system consists of some number of modules. The following data are available. **[8]**

Sub system (i)	Number of modules (Ni)	Importance factor (Wi)	Operating Time (ti) hours
1	25	1.00	20
2	80	0.97	18
3	45	1.00	20
4	60	0.93	14
5	70	1.00	20

Find the individual reliabilities of the sub-systems.

OR

Q6) a) Find the reliability of the system shown in Fig. 4 using Conditional Probability Method. **[8]**
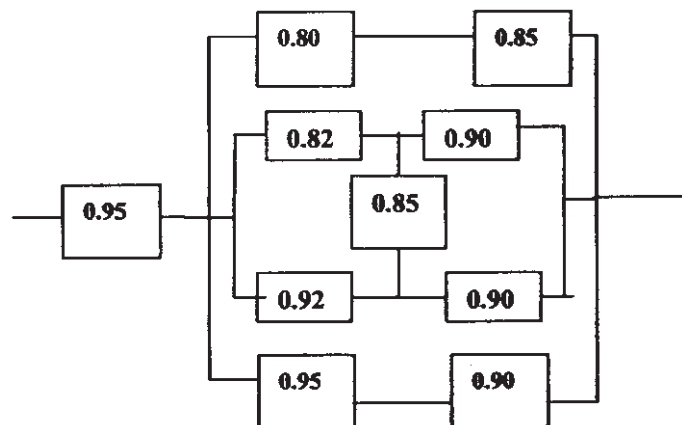
Fig. 4

b) Evaluate the reliability of the system shown in Fig. 5 using Tie set and cut set method. Reliability of each component, **[8]**

$$R(A) = R(B) = R(C) = R(D) = 0.99$$
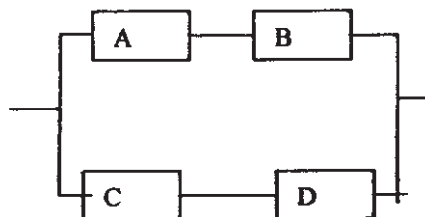
Fig. 5

Q7) a) Explain the types of loads considered in designing machines and structures. **[8]**

b) If the mean value and the standard deviation of the load in a heavy manufacturing plant are 125 Kg/Cm² and 62.5 Kg/Cm² respectively. Determine the probability of failure of system if load exceeding 150 Kg/Cm³. Assume lognormal distribution and table shows $\Phi(z)$ values. **[8]**
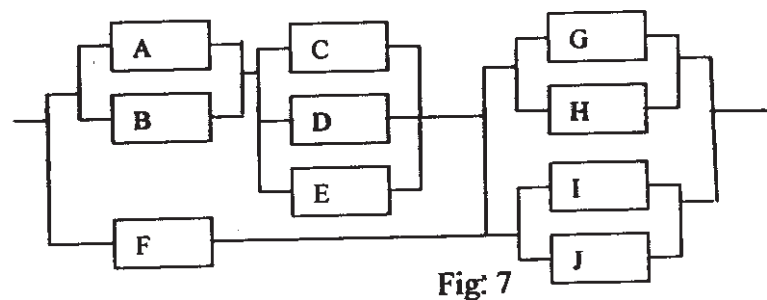
Z	0.9	0.91	0.92	0.93
$\Phi(z)$	0.8159	0.8185	0.8212	0.8238

OR

Q8) a) Fig. 6 shows the fault tree diagram. The probability of failure of each basic fault is given. Find out the reliability of the system. **[8]**

P(a)= 0.01

P(b)= 0.1

P(c)= 0.05

Fig. 6
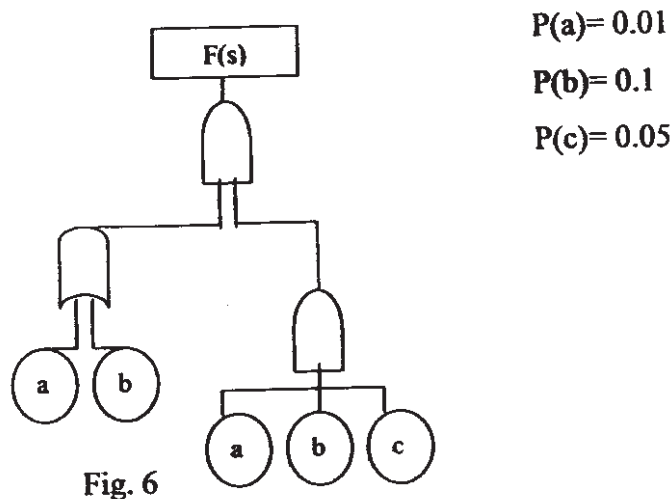
b) Construct a fault tree for the system failure shown in Fig. 7 and write the expression for it. The letters in the block indicates basic elements. **[8]**

Fig: 7

Q9) a) Find the reliability and the corresponding central factor of safety of a system for which $\mu_s=15000$ Kg/cm² and $\mu_L=15000$ Kg/cm². $\sigma_s=3000$ Kg/cm² and $\sigma_L = 1000$ Kg/cm² and S & L follows normal distribution. The table shows normal variant (z) and $\Phi(z)$. **[8]**

Z	1.56	1.58	1.60
$\Phi(z)$	0.9406	0.9429	0.9452

b) Explain laws of Boolean algebra used in Probability Analysis. **[8]**

OR

Q10) a) How the criticality of the component is obtained using FMECA and RPN? **[8]**

b) Explain with suitable sketch the logic gates and symbols used in construction of fault tree diagram. **[8]**

Q11) a) Explain the strategies of accelerated testing for any system. **[8]**

b) In a short sample "accelerated life testing" of a system, based on Weibull distribution the following data are recorded. **[10]**

Failure No.	MTTF (Hrs)
1	28
2	12
3	21.5
4	26
5	36
6	38
7	30
8	32

Plot the variation of reliability against time using i) Mean and ii) Median Ranking Method.

OR

*Q12)*a) Construct a fault tree for the system failure shown in Fig. 8 and write the expression for it. The letters in the block indicates basic elements. Also find the reliability of the system if each element has failure probability of 0.1. **[10]**
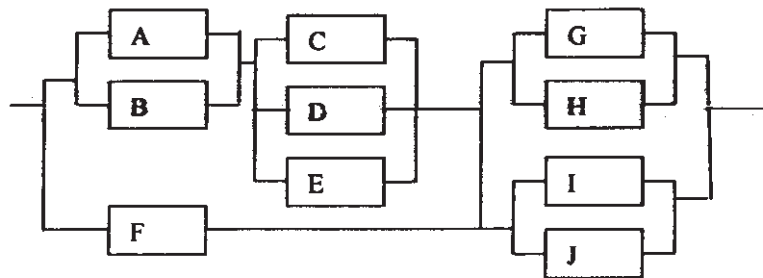
```
        A           C            G
        B           D            H
                    E            I
        F                        J
```

Fig. 8

b) Explain the procedure for construction of FMECA Table for any mechanical system. **[8]**

P1197   **[3564] - 138**

B.E. (Mechanical Engineering)
RAPID PROTOTYPING
(402050) (2003 Course) (Elective)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) *Answer any three questions from each section.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Figures to the right indicate full marks.*
4) *Neat diagrams should be drawn wherever necessary.*
5) *Assume suitable data, if necessary.*

SECTION - I

Q1) a)   Explain with example benefits of RP to   **[8]**
   i)   Design Engineer   ii)   Tool Design Engineer
   iii) Production Engineer   iv)   Marketing Engineer.

   b)   Differentiate between RP and Conventional Manufacturing Process.**[4]**

   c)   Explain principles of Simultaneous Engineering with neat sketch.   **[4]**

Q2) a)   Define Models and explain their influence to speed up product development process with neat sketch.   **[8]**

   b)   Explain with flow chart, data flow in Rapid prototyping.   **[4]**

   c)   Explain basic requirement of CAD System in case of RP.   **[4]**

Q3) a)   Differentiate STL and SLC file formats with sketches.   **[4]**

   b)   Explain the principle of layer generation in SL technology with neat sketch.   **[6]**

   c)   Explain method of layer projection with laser and without laser with examples of each type.   **[6]**

Q4) a)   Differentiate between Solid based, Liquid based and Powder based RP Processes with example of each type.   **[8]**

   b)   Explain stair stepping effect with sketch.   **[4]**

   c)   What are the various data acquisition techniques in Reverse engineering?   **[4]**

P.T.O.

Q5) Write short notes [18]

    a)   SGC.

    b)   LLM Technology and its applications.

    c)   RP and CNC.

SECTION - II

Q6) a)   What are various type of materials used for RP? [4]

    b)   Explain the concept of Support structure and material in RP with neat sketch. [4]

    c)   Explain the process of precision casting using SL models. [8]

Q7) a)   Explain the following terms : [6]

       i)   Direct Rapid Tooling.

       ii) Indirect Rapid Tooling.

    b)   What are the major differences between the mechanical properties of metals and plastics? [4]

    c)   What are solid based materials and liquid based materials used in RP? [6]

Q8) a)   What is RTV? Describe how it works with sketch? [6]

    b)   Explain with neat sketch Spray Metal Molding process. [6]

    c)   What is LENS? How does it work? [4]

Q9) a)   Name four areas of RP applications in Medical field and briefly describe how RP technology is improving each area. [8]

    b)   Explain whether RP technology is more suitable for "high technology" industries like aerospace than it is for consumer products industries like electronics appliances. [8]

Q10) Write short notes [18]

    a)   Guidelines for implementation of RP.

    b)   Criteria for evaluating a type of RP process with a case study.

    c)   Present and future trends of RP.

✦ ✦ ✦ ✦

P1105   **[3564] - 136**

B.E. (Mechanical)

COMPUTATIONAL FLUID DYNAMICS

(2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

    1)   *Answer any 03 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)   *Figures to the right indicate full marks.*

    5)   *Assume suitable data, if necessary.*

SECTION - I

Q1) a)   For infinitesimally small fluid element moving with flow obtain the non-conservation form of energy equation. **[12]**

    b)   Define substantial derivative. **[4]**

<div align="center">OR</div>

Q2) Consider system of quasi-linear equations given below- **[16]**

$$a_1 \frac{\partial u}{\partial x} + b_1 \frac{\partial u}{\partial y} + c_1 \frac{\partial v}{\partial x} + d_1 \frac{\partial v}{\partial y} = f_1$$

$$a_2 \frac{\partial u}{\partial x} + b_2 \frac{\partial u}{\partial y} + c_2 \frac{\partial v}{\partial x} + d_2 \frac{\partial v}{\partial y} = f_2$$

Explain the criteria and different types of quasilinear equations.

Q3) a)   Explain modified mid point method and state how it is used to eliminate error. **[8]**

    b)   Outline the procedure for adaptive stepping with Ranga-Kutta scheme. **[8]**

<div align="center">OR</div>

Q4) Using Von-Neuamann stability method obtain following condition -

$$\frac{\alpha \Delta t}{(\Delta x)2} \leq \frac{1}{2}$$ for parabolic equation. **[16]**

Q5) a) For unsteady one dimensional conduction equation, develop the finite difference equation by - **[14]**

   i) Explicit method.

   ii) Crank Nicolson method.

   iii) Implicit method.

   State their advantages and disadvantages.

   b) Explain briefly different types of errors encountered in numerical methods. **[4]**

<div align="center">OR</div>

Q6) a) Explain the physical significance of CFL condition in relation with characteristic lines for hyperbolic equation. **[10]**

   b) Obtain following relation. **[8]**

$$\left(\frac{\partial^2 u}{\partial X^2}\right)_{ij} = \frac{-u_{i+2,j} + 16u_{i+1,j} - 30u_{i,j} + 16u_{i-1,j} - u_{i-2,j}}{12(\Delta X)^2} + O(\Delta X)^4$$

SECTION - II

Q7) Consider two dimensional heat conduction in rectangular bar as shown in diagram with boundary conditions.
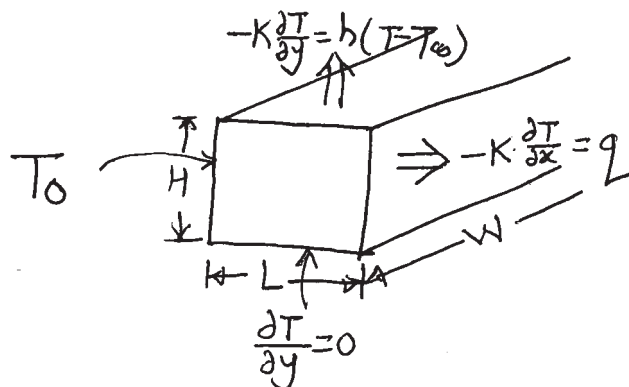
   a) Write the simplified governing equation with boundary condition. **[4]**

   b) Present the discretised form of equation for internal and surface grid points. **[8]**

   c) Assuming 4 x 4 grid points outline procedure to obtain solution. **[4]**

<div align="center">OR</div>

Q8) For two dimensional transient heat conduction, for constant thermal diffusivity.

    a)   Write discretised form of equation. **[6]**

    b)   Outline the procedure to obtain numerical solution by ADI technique.**[8]**

    c)   State the advantages of ADI technique. **[2]**

Q9) Obtain pressure correction formula as given below and comment on its properties. **[16]**

$$ap'_{i,j} + b\,p'_{i+1,j} + b\,p'_{i-1,j} + c\,p'_{i,j+1} + c\,p'_{i,j-1} + d = 0.$$

OR

*Q10)*a)   Write down step by step procedure for the SIMPLE algorithm. **[10]**

    b)   Why is staggered grid adopted for incompressible flows? Sketch checker board velocity and pressure distribution and comment on it. **[6]**

*Q11)*For quasi one dimensional compressible flow in converging - diverging nozzle.

    a)   Derive continuity, momentum and energy equation in terms of non-dimensional variables. **[14]**

    b)   Write these above equations in discretised form. **[4]**

OR

*Q12)*a)   Describe the Mac Cor mack method for evaluating density at node (i, j) at a time step $t + \Delta t$. **[12]**

    b)   List the features and advantages of the finite volume method. **[6]**

P1104   **[3564] - 134**

B.E. (Mechanical)
INDUSTRIAL FLUID POWER
(2003 Course) (402049)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

    1)   *Answer 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)   *Figures to the right indicate full marks.*

    5)   *Use of electronic pocket calculator is allowed.*

    6)   *Assume suitable data, if necessary.*

SECTION - I

Q1) a)   Discuss any six important factors considered for selection of hydraulic fluids. **[6]**

     b)   List the various types of hydraulic fluids. Discuss petroleum base fluids and fire resistant fluids. **[6]**

     c)   Explain with the help of graphs, the effect of temperature and pressure on hydraulic fluids. **[6]**

<div align="center">OR</div>

Q2) a)   Draw a neat sketch of non positive seal. **[6]**

     b)   What are the quality requirements of a good hydraulic fluid? **[6]**

     c)   Explain applications of fluid power in mining industry? **[6]**

Q3) a)   List the performance parameters of a spur gear pump. Further explain the performance characteristics of a spur gear pump. **[8]**

     b)   An accumulator has a ram 0.3 m and 6 m lift and is loaded with 800 kN total load. If packing friction is equivalent to 5 percent of the load on the ram, determine the power being delivered to the machine, if the ram falls steadily through its full range in 90 seconds and if at the same time the pumps are delivering 30 liters per second through the accumulator. **[8]**

<div align="center">OR</div>

Q4) a) Sketch any two types of return line filters and explain their working.**[8]**

b) Explain different applications of accumulators in hydraulic systems.**[8]**

Q5) a) Explain the working of pilot operated direction control valve and solenoid operated direction control valve with neat sketches. **[8]**

b) Draw a neat sketch of a restrictor type pressure compensated flow control valve. **[8]**

OR

Q6) a) What is unloading valve? Discuss it with a neat sketch. **[8]**

b) Explain the working of variable restrictor valve. Discuss variation of flow rate over the pressure drop for such a valve. **[8]**

SECTION - II

Q7) a) Why is cushioning needed in a hydraulic cylinder? What is the meaning of fixed and adjustable cushioning? **[8]**

b) What factors will you consider in selecting a hydraulic motor? Mention two applications of usage of hydraulic motor with their types. **[8]**

OR

Q8) a) Explain the advantage of using a double pump for a press application instead of a single pump. Give a suitable example. **[8]**

b) Draw a circuit for a milling machine for the following movements. Three cylinders are to be used: **[8]**

● Cylinder A for bed movement in X direction.

● Cylinder B for bed movement in Y direction.

● Cylinder C for tool movement.

For feed / speed control, use a standard manifold.

Q9) a) What are the advantages of an air motor over electric motor and hydraulic motor? **[4]**

b) Draw and explain a typical compressed air generation and distribution system. **[8]**

c) Write a note on selection criteria of compressor for pneumatic systems.**[4]**

OR

*Q10)*a)   Explain following components with application: **[8]**

1)   Pneumatic / vacuum clamp.

2)   Shuttle / OR valve.

b)   The automatic door of a bus is operated by a double acting cylinder. Both the opening and closing of the door are performed with a selector switch. The time duration for which the door is kept open, is decided by the bus driver. The speed of closing and opening the door is adjustable. Draw the Pneumatic circuit.   **[8]**

*Q11)*a)   Explain in the importance of specification and performance curves of fluid power components.   **[6]**

b)   A carton weighing 25 kg is to be lifted through a height of 200 mm. It has to be then pushed on to a conveyor. The pushing length required is 300 mm. Compressed air is available for this facility at 5 kg/cm².

The sequence is that the lifting cylinder should start first to lift the weight, and then the pushing cylinder to push the carton. Once the carton is pushed through a distance of 300 mm, the pushing cylinder retracts and then only the lifting cylinder retracts.

Design and draw the circuit.   **[12]**

OR

*Q12)*For the double pump system as shown in figure, what should be the pressure settings of the unloading valve and pressure relief valve under the following conditions: **[18]**

a)   Sheet metal punching operation requires a force of 8000 N.

b)   Hydraulic cylinder has a 3.75 cm diameter piston and a 1.25 cm diameter rod.

c)   During rapid extension of the cylinder, a frictional pressure loss of 675 kPa occurs in the line from the high flow pump to the blank end of the cylinder. During the same time, a 350 kPa pressure loss occurs in the return line from the rod end of the cylinder to the oil tank. Frictional pressure losses in these lines are negligibly small during the punching operation.

d)	Assume that the unloading valve and relief valve pressure settings (for their full pump flow requirements) should be 50% higher than the pressure required to overcome frictional pressure losses and the cylinder punching load respectively.
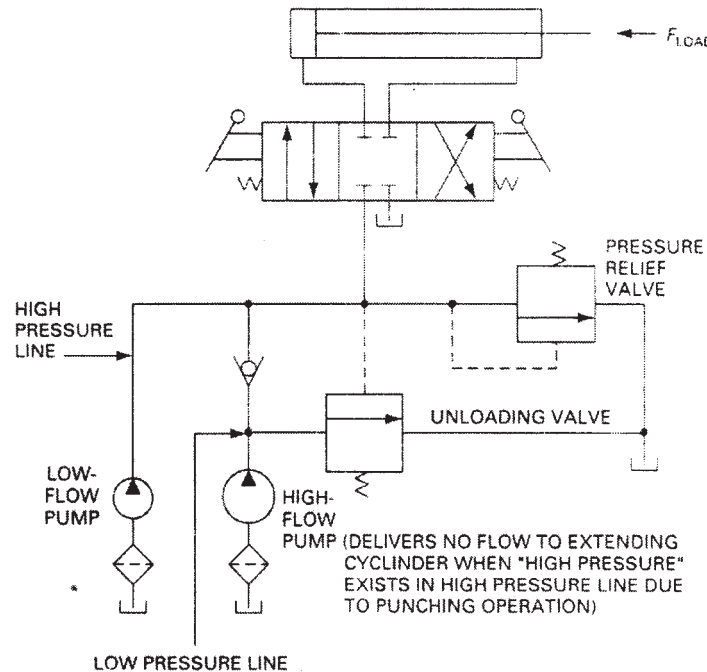
P1103   **[3564]-133**

B.E. (Mechanical Engg.)

POWER PLANT ENGINEERING

(2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

1) *Answers to the two sections should be written in separate books.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *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

Q1) a) List and explain the factors affecting selection of site for thermal power station. **[6]**

b) What are the main components of a Gas turbine power plant? List the advantages of Gas turbine power plant. **[4]**

c) Write a note on present status of power generation in India. **[6]**

OR

Q2) a) With the help of a neat sketch explain the working of a boiling water reactor (BWR). **[8]**

b) What are pumped storage plants? What are their advantages and limitations? Where such schemes can be applied (used)? **[8]**

Unit - II

Q3) a) What is coal benefication? What are its advantages? **[7]**

b) State the characteristics of a good ash handling plant. How dust collectors are classified? **[9]**

OR

Q4) a) What do you understand by Fluidised bed combustion? Explain its working principle with the help of a neat sketch. **[8]**

b) Coal Methane Mixture (CMM) is considered most promising than Coal Oil Mixture (COM) and Coal Water Mixture (CWM). Why? Discuss in detail. **[8]**

Unit - III

Q5) a) With a neat sketch explain Benson boiler. What are its merits and demerits in comparison with Velox boiler. **[9]**

b) What are the basic requirements of steam piping used in power plants? What are the steps involved in designing of steam piping? **[9]**

OR

Q6) a) Sketch a typical layout of a modern steam power plant with superheating, reheating (2 reheaters) and regenerative feed heating. Show on T-S diagram. **[6]**

b) In a reheat cycle, steam at 500ºC expands in a HP turbine till it is saturated vapour. It is reheated at constant pressure to 400ºC and then expands in a LP turbine to 40ºC. If the maximum moisture content at turbine exit is limited to 15%, determine

i) reheat pressure   ii) boiler pressure

iii) cycle efficiency   iv) steam rate.

Assume all processes to be ideal.

What would have been the quality at turbine exit and cycle efficiency without reheating? **[12]**

SECTION - II

Unit - IV

Q7) a) From first principles, show that the critical pressure ratio,

$$P_2/P_1 = \left(\frac{2}{\gamma+1}\right)^{\frac{\gamma}{\gamma-1}}; \text{ where } \gamma \text{ is adiabatic index.}$$ **[8]**

b) Steam at 3 bar, 150°C expands in a converging nozzle to a pressure of 1.7 bar. The exit area of the nozzle is $3cm^2$ and inlet velocity is 50 m/s. Calculate the exit velocity and mass flow rate if

i) Expansion is in equilibrium throughout.

ii) Expansion is in supersaturated state.

Solve by steam table only. **[8]**

OR

Q8) a) With the help of T-S diagram explain the necessity of condenser in a steam power plant? **[6]**

b) Define condenser efficiency and vacuum efficiency. **[4]**

c) What are the sources of air leakage in a condenser? Explain one type of air pump. **[6]**

Q9) a) Derive the expression for maximum blade efficiency of a reaction turbine. **[9]**

b) In a certain stage of a reaction turbine, the steam leaves the fixed blade at a pressure of 3 bar, 0.98 dry and a velocity of 130 m/s. The blades are 20 mm high and the discharge angle for both the blades is 20°. The ratio of axial velocity of flow to the blade velocity is 0.7 at inlet and 0.76 at exit from moving blades. If the turbine uses 4 kg/s of steam with 5% tip leakage; determine the mean blade diameter and power developed in the ring. **[9]**

OR

Q10) a) What is the necessity of compounding of steam turbines? Explain different methods of compounding. **[8]**

b) Steam enters an impulse wheel having a nozzle of 20° at a velocity of 450 m/s. The exit angle of the moving blades is 20° and relative velocity of steam may be assumed to remain constant over the moving blades. If the blade speed is 180 m/s determine (i) blade angle at inlet (ii) work done /kg of steam (iii) power developed when the turbine is supplied with 2.5 kg/s of steam (iv) diagram efficiency. **[10]**

Unit - VI

Q11) a) Discuss in detail how unit energy cost is determined. **[8]**

b) Two power plants, A and B, have incremental fuel costs given by;

$$\frac{dF_A}{dP_A} = 0.06\,P_A + 30 \text{ and } \frac{dF_B}{dP_B} = 0.07\,P_B + 25$$

where F is fuel cost in rupees per hour and P is power output in MW. If the total power supplied by both units is 500 MW, find the economic loading of the two units. The net increase or decrease in fuel cost / h if the load is equally shared. **[8]**

OR

Q12) a) Explain with sketch what is load curve and load duration curve. How average load is calculated? **[8]**

b) A power plant has following data available : Load factor = 70%, Capacity factor = 50%, Plant use factor = 60%, Maximum load = 30 MW. Calculate (i) Annual energy production. (ii) Reserve capacity over and above peak load. (iii) Number hours the plant is not in operation per year. **[8]**

P1102   **[3564]-132**

B.E. (Mechanical)
CAD / CAM AND AUTOMATION
(2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :
  1) *Answer 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) *Figures to the right indicate full marks.*
  5) *Use of calculator is allowed.*
  6) *Assume suitable data, if necessary.*

SECTION - I

Q1) a) Derive the concatenated transformation matrix for scaling with respect to any reference point (xr, yr). **[6]**

  b) A triangle A(2, 2), B(4, 4), C(3, 5) has undergone the following operations. Find the concatenated matrix and then find new coordinates of Δ ABC.

  1) Mirrored about line $y = x$.

  2) Scaled w.r.t. to point (2, 2).

  3) Rotated by 45° in clockwise direction about (2, 2). **[10]**

OR

Q2) a) Derive the concatenated transformation matrix for mirroring about $y = mx + c$. **[8]**

  b) A triangle A(2, 2), B(4, 4), C(3, 5) in active coordinate system. Find the coordinate of Δ ABC in world coordinate system. The coordinate of origin of active coordinate system is (2, 2) in world coordinate system. **[8]**
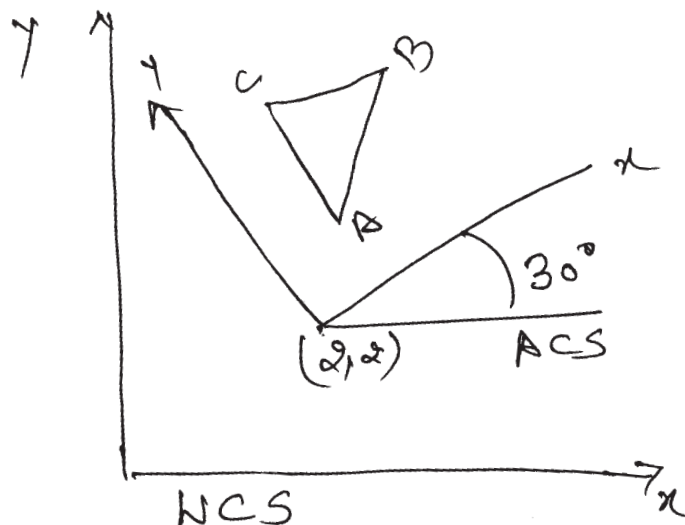
Q3) a) Explain the advantages of parametric equation over the analytical equation of curve. **[6]**

b) A circle is passing through two end points A(6, 4) and B(10, 10) where AB is the diameter of the circle. Find the coordinates of centre point, radius, parametric equation of circle. Find the coordinates of points lies on the circle at $\theta = 30°$ and $\theta = 120°$. **[10]**

<div align="center">OR</div>

Q4) a) Explain Bezier and B-spline curve. **[8]**

b) Explain following terms with respect to surface modeling. **[8]**

1) Tabulated surface.

2) Edge defined surface.

3) Revolved surface.

4) Swept surface.

Q5) a) Explain penalty approach to solve one dimensional FEM problems. **[6]**

b) Find the stresses and reaction at the support by modeling following system in two finite elements. Use penalty approach. **[12]**
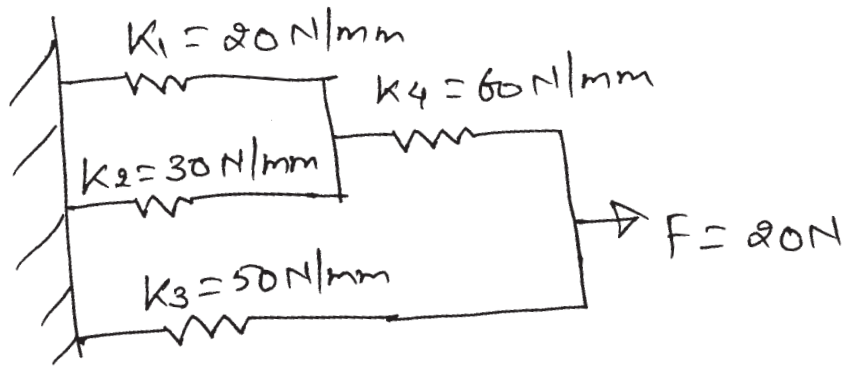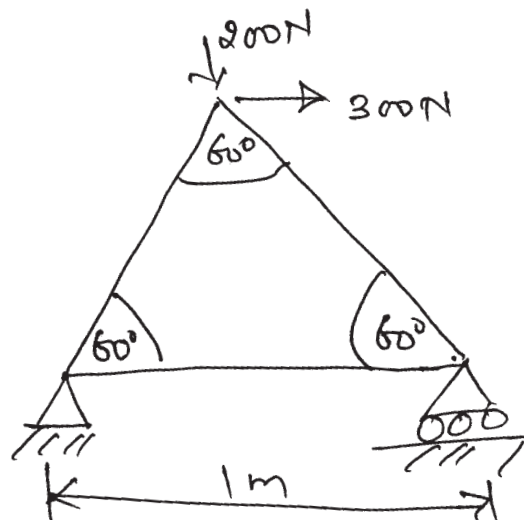
$$E = 2 \times 10^5 \text{ N/mm}^2$$

<div align="center">OR</div>

Q6) a)
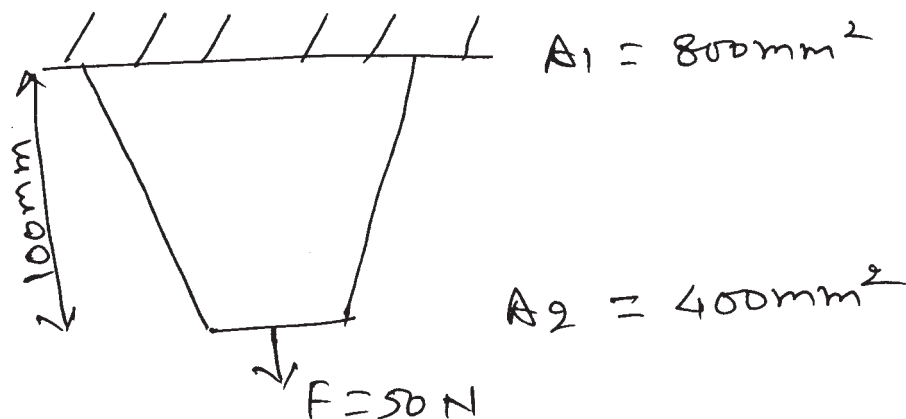
Find the deflection of each springs.

[6]

b)

The cross sectional area of each element is 500 mm². Find reaction at the support and stresses in each elements. **[12]**
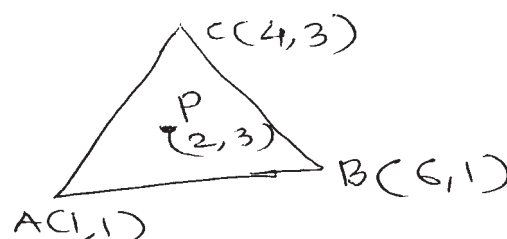
SECTION - II

Q7) a) What is CST? Explain different characteristics of CST element. **[8]**

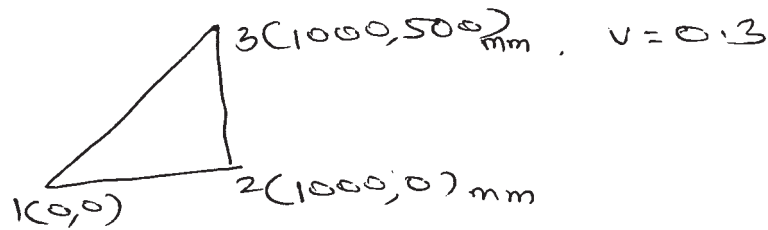b) Derive shape function for linear quadrilateral isoparametric element.**[10]**

OR

*Q8)* a) For a point P located in side triangle as shown below, find the shape function at point P. **[8]**

b) Differentiate between linear and quadratic CST element.

Find element stiffness matrix for CST element shown in figure. Take $E = 2 \times 10^5$ N/mm^2. **[10]**

Q9) a) What is tool compensation? Explain its need & how it is incorporated in the program? **[6]**

b) Write a part program to drill holes in given component on CNC milling machine. Take work material Aluminium, tool material HSS. **[10]**
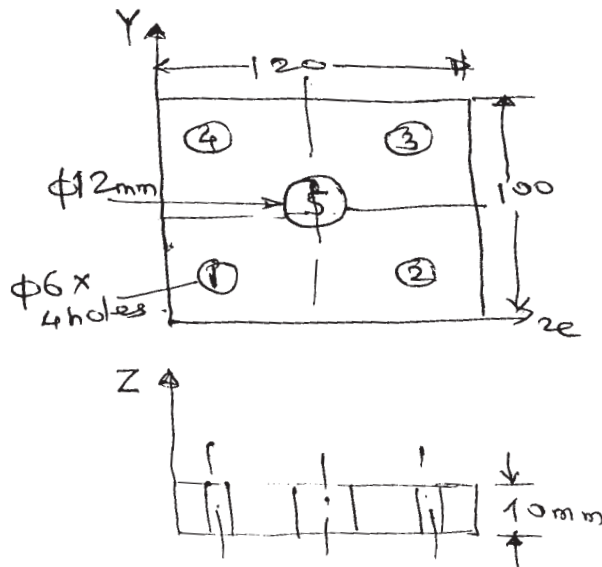
Co-Ordinate Table

Point	x	y
1	30	30
2	90	30
3	90	70
4	30	70
5	60	50

OR

Q10) a) Explain GO2, GO3 codes in detail with suitable example. **[6]**

b) Differentiate between - **[10]**

i) CNC and DNC machines.

ii) Point-to-point and contouring operation.

iii) Modal and non-modal G-codes.

Q11) a) What do you mean by FMS layout? List different types of layouts and explain any one layout with neat diagram. **[8]**

b) Define CIM. What are different elements of CIM? **[8]**

OR

Q12) a) Explain basic elements of a Robot. How robots are classified? **[8]**

b) Explain following terms related to Robots. **[8]**

   i) Work volume.

   ii) Accuracy and repeatability.

   iii) Wrist motions.

   iv) Automated guided vehicle (AGV).

Total No. of Questions : 12]　　　　　　　　**[Total No. of Pages : 4**

P1101　　　　　　　　**[3564] - 131**

B.E. (Mech.)

COSTING & COST CONTROL

(402045) (2003 Course)

Time : 3 Hours]　　　　　　　　　　　　　　　　　*[Max. Marks : 100*

Instructions to the candidates:

　　1)　Answers to the two sections should be written in separate answer books.

　　2)　Figures to the right indicate full marks.

　　3)　Use of electronic pocket calculator is allowed.

　　4)　Assume suitable data, if necessary.

SECTION - I

Q1) a)　Explain in brief the contents & importance of the following reports prepared by a Cost Accounting Department.　　**[10]**

　　　i)　　Cost sheet.

　　　ii)　　Consumption of material statement.

　　　iii)　Labour utilization statement.

　　　iv)　Statement showing overheads incurred compared with budgets.

　　　v)　　Statement showing sales effected compared with budgets.

　　b)　Explain in brief cost classification according to　　**[8]**

　　　i)　　Nature.

　　　ii)　　Function.

　　　iii)　Variability.

　　　iv)　Normality.

<div align="center">OR</div>

Q2) a)　State any 5 limitations of cost accounting.　　**[10]**

　　b)　The following information is available for the financial year 2007-2008 for a manufacturing company.　　**[8]**

　　　Opening stock of direct materials : Rs. 3,00,000/-.

　　　Closing stock of direct materials : Rs. 2,00,000/-.

　　　Direct materials purchased during the year : Rs. 7,00,000/-.

　　　Direct wages : Rs. 10,50,000/-.

　　　Direct expenses : Rs. 2,25,000/-.

　　　Indirect materials : Rs. 80,000/-.

<div align="right">*P.T.O.*</div>

Indirect wages : Rs. 70,000/-.

Indirect expenses : Rs. 1,00,000/-.

Calculate prime cost, over head and total cost.

Q3) a) Explain the procedure of charging overheads to cost units. **[8]**

b) State the basis of apportionment of expense of the following service departments (2 each). **[8]**

i) Tool Room.

ii) Human Resource.

iii) Guest House.

iv) Finance.

OR

Q4) a) Explain under-absorption and over-absorption of over head with suitable illustration. **[8]**

b) Enumerate advantages of classifying overhead according to variability. **[8]**

Q5) a) What is budget? What is budgetary control? Explain steps involved in budgetary control. **[8]**

b) What is variance analysis? Explain material cost variance & material usage variance. **[8]**

OR

Q6) a) Explain continuous apportionment method for apportioning expenses incurred by the departments providing interdepartmental service. **[8]**

b) The primary distribution summary of overhead is furnished below. **[8]**

Type of Department	Name of Department	Amount of overhead Rs.
Production	Machine shop	20,00,000/-
	Assembly shop	8,00,000/-
Service	Canteen	4,00,000/-
	Power house	6,00,000/-

The canteen is to be apportioned on the basis of the employees strength.

Shop	Employees strength	%
Machine	240	60
Assembly	140	35
Power house	20	5

The power house is to be apportioned on the basis of electricity usage.

Shop	Thousands kW	%
Machine	270	75
Assembly	36	10
Canteen	54	15

Apportion the service departmental overheads to the production departments.

SECTION - II

Q7) a) Give the utility of Joint Cost determination. Give any two examples where Joint Cost evaluation is necessary. **[6]**

b) ABC limited manufactures product A; which gives two joint products B & C. **[12]**

Joint cost for a period was Rs. 8,00,000/-

The estimated profit as a percentage of sales price for products A, B & C was 30%, 25% & 15% respectively.

Expenses after split-off point were as follows.

	A	B	C
Material (Rs.)	10,000	7,500	2,500
Direct wages (Rs.)	20,000	12,500	5,000
Overheads (Rs.)	15,000	12,500	7,500
Total (Rs.)	45,000	32,500	15,000
Sales (Rs.)	6,00,000	4,00,000	2,50,000

Prepare a statement showing the apportionment of Joint Expenses over different products.

OR

Q8) a) What are the methods of allocation of Joint Costs upto split-off point to the products produced? Mention any three methods in brief. **[6]**

b) Two products X & Y are obtained at split-off point and need further processing at a cost of Rs. 5 & Rs. 4 respectively for X & Y (per unit). During a month the Joint cost was Rs. 88,000/- and the output for X & Y was 8,000 units & 6,000 units respectively.

Apportion the Joint Cost to X & Y, if the sales price per unit for X & Y are Rs. 13.75 & Rs. 8.75 respectively and net margin is 25% of the cost. **[12]**

Q9) a) Explain the concept of Break-Even point. What are its limitations? Discuss any three in brief. **[8]**

b) What are the risks involved if p/v ratio is high? Give any two examples each where p/v ratio is expected to be too high & too low. **[8]**

OR

*Q10)*a) Explain the meaning of the term 'Contribution'. What does it contribute to? **[6]**

b) Define variable cost & fixed cost. Give any two examples of each of these. **[4]**

c) What is meant by margin of safety? Explain the relationship between Margin of safety & different costs graphically. **[6]**

*Q11)*a) "Budget is essential for standard costing and vice-a-versa". Do you agree with the statement? Justify your answer. **[8]**

b) Explain the basic philosophy of Activity Based Costing. Do overheads exist under this method of costing? Justify your answer. **[8]**

OR

*Q12)*a) Define the term 'Marginal Cost'. Does it defer from variable cost? Justify. **[6]**

b) What are the uses of Marginal costing method? Explain with suitable examples. **[6]**

c) What is meant by 'Cost Driver'? For which costing technique this term is used? **[4]**

✦✦✦✦

P1257 **[3564] - 130**

B.E. (Mech.)

OPERATIONS RESEARCH

(402045) (2003 Course) (Elective - I)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate books.*
2) *Figures to the right indicate full marks.*
3) *Use of nonprogrammable calculator, stats table etc. permitted.*
4) *Assume suitable data, if necessary and state it clearly.*

SECTION - I

Q1) a) Explain in brief phases in O.R. **[5]**

b) A paper mill produces rolls of paper used in cash registers. Each roll of paper is 100 m in length and can be used in widths of 3, 4, 6, & 10 cm. The company's production process results in rolls that are 24 cm in width. Thus the company must cut its 24 cm roll to the desired widths. It has six basic cutting alternatives as follows :

Cutting alternatives	Width of rolls (cm.)				Waste (cm.)
	3	4	6	10	
I	4	3	-	-	-
II	-	3	2	-	-
III	1	1	1	1	1
IV	-	-	2	1	2
V	-	4	1	-	2
VI	3	2	1	-	1

The minimum demand for four rolls is as follows :

Roll width (cm.) 2 4 6 10

Demand 2000 3600 1600 500

The paper mill wishes to minimise the waste resulting from trimming to size.

i) Formulate the L.P. model. Do not solve the problem. **[6]**

ii) If problem is to be solved by simplex method, how many total variables are involved of each type? **[3]**

c) Define the following terms in L.P. **[4]**
   i) Slack variable.
   ii) Redundant constraint.
   iii) Replacement ratio.
   iv) Degenerate solution.

OR

a) Solve by Simplex method. **[8]**
   Max. $Z = 3x_1 + 4x_2$
   S.t. $x_1 + x_2 \leq 450$
   $\quad 2x_1 + x_2 \leq 600$ & $x_1, x_2 \geq 0$

b) If above represent mathematical model for 2 resource, 2 product mix problem then -
   i) Which resource is not fully utilised? By what amount? **[2]**
   ii) If a new product (say 3rd) takes 2 units of both resources, for what value of profit, this product should be manufactured? **[2]**

c) Write any six changes involved in converting any given primal to dual. **[6]**

Q2) a) Obtain IBFS for 3 origin, 3 destination unbalanced transportation problem by Matrix Minima method, having any one route as prohibited one. Check only, whether this IBFS is optimal or not by stepping stone method evaluation for all empty cells. Assume any suitable data for availabilities & requirements. Assume different suitable unit transportation costs along different routes. **[12]**

b) Write transportation model for an assignment problem and LPP form for transportation problem. **[4]**

OR

a) The captain of a cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows :

Batsman	Batting Position				
	I	II	III	IV	V
P	40	40	35	25	50
Q	42	30	16	25	27
R	50	48	40	60	50
S	20	19	20	18	25
T	58	60	59	55	53

    i)   Find the assignment of batsmen to positions which would give the maximum number of runs. **[7]**

    ii)   If another batsman 'U' with following average runs in batting positions as given below :

       Batting positions :   I   II   III   IV   V

       Average runs   :   45   52   38   50   49

       is added to the team, should he be included to play in the team?**[4]**

       If so, who will be replaced by him? **[1]**

b)   Discuss the travelling salesman problem. **[4]**

Q3) a)   Summarise the procedure adopted in the analysis of dynamic programming problems. **[4]**

b)   Discuss in detail the various inventory costs associated with the manufacturing organisation. **[6]**

c)   A manufacturing company requires a component at the annual average rate of 1,000 units. Placing an order costs Rs. 480 with 5-day lead time. Holding cost is estimated at Rs. 15 per unit/year. The plant operates 250 days/year. It is assumed that daily demand is normally distributed with an average of 4 units with a standard deviation of 1.2 units. Suggest an inventory policy to control the inventory of the item based on a 95% service level. **[6]**

OR

a)   A pharma company consumes annual 6,000 kg. of a chemical costing Rs. 5/kg. ordering cost is Rs. 25 & carrying cost is 6% per year / kg. of average inventory. Find EOQ and the total inventory cost (including the cost of chemicals). If the supplier offers a discount of 5% on the cost price for a single order of annual requirement, should the factory accept it? **[8]**

b)   Solve the following NLPP by graphical method. **[5]**

$$\text{Min } Z = x_1^2 + x_2^2 \text{ s.t. } x_1 + x_2 \geq 8,\ x_1 + 2x_2 \geq 10$$

$$2x_1 + x_2 \geq 10,\ x_1 \ \& \ x_2 \geq 0$$

c)   Explain the concept of cutting plane algorithm. **[3]**

SECTION - II

Q4) a) In a small town there are only two stores, ABC and XYZ that handle sundry goods. The total number of customers is equally divided between the two, because price and quality of goods sold are equal. Both stores plan to run annual pre-Diwali sales during the 1ˢᵗ week of November. Sales are advertised through a local news paper, radio and cable TV. With the aid of an advertising firm, store ABC constructed the game matrix given below. (Figures in matrix represent a gain or loss of market share).

		Strategy of XYZ		
		News Paper	Radio	TV
Strategy of ABC	News Paper	30	40	-80
	Radio	0	15	-20
	TV	90	20	50

Determine optimal strategies for both ABC & XYZ & value of game. **[9]**

b) A taxi owner estimates from his past records that the cost / year for operating a taxi whose purchase price when new is Rs. 60,000 are as -

Age - 1 2 3 4 5

Operating cost (Rs.) - 10,000 12,000 15,000 18,000 20,000

After 5 years, the operating cost = 6000 K, where K = 6, 7,......10 (K is age in years). If resale value decreases by 10% of purchase price each year, what is the best replacement policy? Cost of money is zero. **[9]**

OR

a) The following rates have been observed for certain items.

End of month - 1 2 3 4 5

Probability of failure - 0.10 0.30 0.55 0.85 1.00

The cost of replacing an individual item is Rs. 1.25. The decision is made to replace all items simultaneously at fixed intervals and also to replace individual items as they fail. If the cost of group replacement is 50 paise, what is the best interval of group replacement? At what group replacements price per item, would a policy of strictly individual replacement become preferable to the adopted policy? Assume that the items failing during a month are replaced at the end of the month & there are 1000 items in use. **[10]**

b) Solve the following game by graphical method. **[8]**

$$\begin{vmatrix} -5 & 5 & 0 & -1 & 8 \\ 8 & -4 & -1 & 6 & -5 \end{vmatrix}$$

Q5) a) The cake manufacturing company manufactures 30 cakes / day. Past record show sales with following distribution.

Sales (no. of cakes) -   27   28   29   30   31   32

Probability   -   0.10   0.15   0.20   0.35   0.15   0.05

The production cost & selling price of each cake is Rs. 40 & Rs. 50 respectively. Any unsold cake is to be disposed off at a loss of Rs. 15 / unit. There is a penalty of Rs. 5/- per unit if the demand is not met. Using following random numbers estimate total profit / loss for the next 10 days.

10, 99, 65, 99, 95, 01, 79, 11, 16, 20.   **[10]**

b) Explain Kendall's notation for representing queing models.   **[6]**

<div align="center">OR</div>

a) Goods trucks arrive randomly at a stockyard with a mean of 8 trucks / hour. A crew of four operatives can unload a truck in 6 minutes. Trucks waiting in queue to be unloaded are paid a waiting change at the rate of Rs. 60 per hour. Operatives are paid a wage rate of Rs. 20 per hour. It is possible to increase the number of crews to 2 or 3 (of four operatives per crew) when the unloading time will be 4 minutes or 3 minutes respectively per truck. Find the optimal crew size.   **[8]**

b) A ready-made garments manufacturer has to process 7 items through two stages of production, viz., cutting & sewing. The time taken for each of these items at different stages are given below in appropriate units :-

Item :   1   2   3   4   5   6   7

Processing time $\begin{cases} \text{Cutting :} & 5 \quad 7 \quad 3 \quad 4 \quad 6 \quad 7 \quad 12 \\ \text{Sewing :} & 2 \quad 6 \quad 7 \quad 5 \quad 9 \quad 5 \quad 8 \end{cases}$

i) Find an order in which these items are to be processed through these stages so as to minimise the total processing time. Find total time elapsed.

ii) Suppose a third stage of production is added, viz pressing, with processing time for these items as follows :

Item   - 1   2   3   4   5   6   7

Processing time (pressing) - 10   12   11   13   12   10   11

State, whether the order is going to change? If yes, what is that order?

                                                                           [8]

Q6) a) Discuss the Fulkerson's Rule used in Network diagram. **[4]**

b) A project has following data to offer.

Head activity	Tail Activity	Estimated duration (months)		
		Smallest	Middle	Highest
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D, E	3	6	15
H	F, G	1	2	3

i) Draw the network & determine expected duration of project. **[6]**

ii) Calculate slack for events. **[2]**

iii) What duration of project will have 95% confidence of project completion? **[2]**

iv) Which activities will cause more uncertainity in meeting the due date of project? **[2]**

OR

Explain in brief (any eight) related to project management. **[16]**

a) Gantt chart.

b) Activity & event.

c) Head & Tail event.

d) Time estimate for an activity.

e) Earliest start & Earliest Finish time for activity.

f) Latest start & Latest finish time for activity.

g) Total float.

h) Free float.

i) Independent float.

Given-For 95% confidence, Z = 1.645.

✦✦✦✦

P1256   **[3564]-128**

B.E. (Mechanical)
ALTERNATIVE ENERGY SOURCES
(2003 Course) (402045) (Elective - I)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

   1)   Answers to the two sections should be written in separate books.
   2)   Neat Diagrams must be drawn wherever necessary.
   3)   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.
   6)   All questions are compulsory.

SECTION - I

Q1) a)   Discuss the present energy scenario in India & Government future strategy for utilization.   **[8]**

   b)   In which direction FPC are kept? What is the tilt angle? Why it is required? How it is decided? Compare the advantages & limitations of FPC with concentrating collectors?   **[8]**

OR

Q2) a)   Why energy demand is increasing? Discuss the energy generation & utilization pattern of few major countries which is causing impact on global energy scenario.   **[8]**

   b)   Discuss the various instruments used for measuring solar radiation data. Explain the working of pyrheliometer.   **[8]**

Q3) a)   Explain the working principle & material selection for different components of FPC. Discuss economy of utilization of FPC for domestic applications.   **[8]**

   b)   Calculate the angle of incidence of beam radiation on a plane surface, tilted by 45º from horizontal plane & pointing 30º west of south located at Mumbai (72º 49' E, 18º 54' N) at 1.30 pm (IST) on 15th Nov. Take equation of time error = 14.74 min. Also estimate daylength on this day.   **[8]**

OR

Q4) a) Explain the construction & performance of evacuated tube collector & compare it with conventional FPC. **[8]**

b) In case of parabolic Trough collector explain the following terms: **[8]**
   i) Concentration Ratio.
   ii) Instantaneous collector efficiency.
   iii) Overall loss coefficient.
   iv) Collector heat removal factor.

Q5) a) Explain the working of solar still & explain its application in desalination system. **[5]**

b) Explain the working of Tower type solar power generation plant. **[5]**

c) Calculate the conversion tilt factors Rb, Rd & Rr at an inclined surface facing due south tilted at 30° with horizontal at a location in a city with latitude 28° 51' on January 1 at 12 noon (solar time). Take the reflection coefficient of ground e = 0.2. **[8]**

OR

Q6) Write short notes on any three of the following: **[18]**
   a) Structure of sun & radiation received on earth.
   b) Testing of Air - driers.
   c) Effect of various parameters on performance of solar pond.
   d) Modes of tracking for concentrators.
   e) Solar architecture.

SECTION - II

Q7) a) Describe savonious type of rotor (vertical axis wind machine) in the following concern with neat sketch. **[10]**
   i) Characteristics & working.
   ii) Advantages & disadvantages.

b) Discuss site selection for wind farms. State atleast two wind farm locations in Maharashtra. **[4]**

c) Which are the Basic components of wind mill? Explain with neat sketch. **[4]**

OR

Q8) a) Explain the operation of a solar photo-voltaic cell. What are the materials used for the same? Also state applications of photo-voltaic cell. **[10]**

b) Explain solar thermal conversion system suitable for the small power plant generating few kW power. **[8]**

Q9) a) Describe a typical geothermal field with a neat sketch. State locations of Geothermal energy in India. **[8]**

b) Discuss prospects of Tidal energy in India. Write suitable locations for the same. **[8]**

OR

Q10) a) Explain vapour dominating geothermal system. **[8]**

b) Describe open cycle OTEC system. **[4]**

c) State different types of fuel cells. Explain working of the fuel cell. **[4]**

Q11) a) What is Gasifier. Describe updraft Gasifier with neat sketch. **[8]**

b) Which are different methods for obtaining energy from biomass? What is anaerobic digestion? **[8]**

OR

Q12) a) Write short note on: **[8]**

i) Use of biogas as diesel fuel.

ii) Environmental protection norms.

b) Discuss variables affecting simple biogas plants. **[8]**

P1100   **[3564]-127**

B.E. (Mechanical)

MATERIAL ENGINEERING & THEIR PROCESSING
(2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates :

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) *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

Q1) Solve the following:

a) Draw the solid state portion of iron-carbon carbon diagram and show the temperatures for Annealing, Normalising and Hardening on it. **[8]**

b) State the relation between microstructure and mechanical properties for hypoeutectoid steels and hypereutectoid steel. **[8]**

OR

Q2) Solve the following:

a) Give the classification of stainless steels and explain the weld decay.**[8]**

b) How high strength steels are produced? Give composition, properties and applications of dual phase steel & HSLA. **[8]**

Q3) Solve the following:

a) Explain the principle of carburising. State the difference between liquid and Gas carburising. **[8]**

b) Draw neat self explainatory figures for martempering, Austempering and Pattenting. **[8]**

OR

Q4) Solve the following:

a) Draw the TTT curves for hypoeutectoid and hypereutectoid steels. Explain the significance of critical cooling rate. **[8]**

b) Why hardened steels are stronger and brittle? How brittleness is eliminated? **[8]**

P.T.O.

Q5) Solve the following:

a) Explain the process of production of S.G. iron and malleable iron. **[8]**

b) Draw the microstructures of the following: **[8]**

    i) Gray cost iron.   ii) C.G. iron.

    iii) Modular iron.   iv) Malleable iron.

c) Why cost iron possess damping property? **[2]**

<p align="center">OR</p>

Q6) Solve the following:

a) Draw the phase diagram for Cu-Zn system. Label all phases, compositions & temperatures. **[6]**

b) Differentiate between single and two phase brasses. **[4]**

c) Explain cladding and anodising techniques. State their advantages & applications. **[8]**

<p align="center"><u>**SECTION - II**</u></p>

Q7) Solve the following:

a) Define composite. How properties are improved with F.R.P.? **[6]**

b) State properties and applications of hybrid composites and sandwich composites. **[4]**

c) State the methods used for producing laminated plastics and explain one process with sketch. **[8]**

<p align="center">OR</p>

Q8) Solve the following:

a) Explain the characteristics of the following fibers (Any four): **[8]**

    i) Silicon carbide.   ii) Glass.

    iii) Carbon.   iv) Boron.

    v) Aluminium.

b) Explain with neat sketches the following (Any two): **[8]**

    i) Hot pressing.

    ii) Squeeze casting.

    iii) Injection molding.

c) State the properties of refractories. **[2]**

Q9) Solve the following:

    a)   Explain the PVD process with sketch. **[6]**

    b)   State the advantages and disadvantages of phosphate coating. **[6]**

    c)   Explain the principle of thin film coating. **[4]**

<div align="center">OR</div>

Q10) Solve the following:

    a)   Explain the CVD coating process with sketch. State the advantages and applications. **[8]**

    b)   Explain the principle of electroless plating. How it differs from plating and coating. **[8]**

Q11) Solve the following:

    a)   What is Nanotechnology? State the advantages and disadvantages of Nanotechnology. **[6]**

    b)   State the methods of production of Nanomaterials. Explain with sketch one process. **[8]**

    c)   List the materials used in dentistry. **[2]**

<div align="center">OR</div>

Q12) Solve the following:

    a)   Compare carbon and Boron nanotubes with respect to structure, mechanical and electrical properties. **[8]**

    b)   Define fullerense. Explain the effect of carbon atoms on the fullerense. **[4]**

    c)   Discuss various properties of steels affected by temperature. Give one example. **[4]**

<div align="center">❧ ☙</div>

P1097   **[3564] - 123**

B.E. (Mech.)
DYNAMICS OF MACHINERY
(2003 Course)

Time : 3 Hours]   *[Max. Marks : 100*

Instructions to the candidates:

1) *Answer 3 questions from Section - I and 3 questions from Section - II.*
2) *Answers to the two sections should be written in separate answer 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

Q1) a) What do you understand by gyroscopic couple? Derive a relation for its magnitude. **[6]**

b) Mass of engine fitted in an aeroplane is 400 kg. The radius of gyration of the revolving masses is 300mm. The sense of rotation of masses is clockwise as viewed from the front of the engine and its speed is 2000 rpm.

Determine the magnitude & direction of the gyroscopic couple acting on the aeroplane. When its speed of flight is 125 km/hr in a circular path of radius 30 m. in anticlockwise direction as viewed from the bottom. **[10]**

OR

Q2) A rail car has a total mass of 4000 kg. There are 2 axles, each of which, together with its wheels & gearing has a total moment of inertia of 30 kg.m². The centre distance between the two wheels on an axle is 1.5 m and each wheel is 465 mm radius. Each axle is driven by a motor, the speed ratio between the two being 1 : 3. Each motor with its gear has a mass moment of inertia of 15 kg. m² and runs in direction opposite to that of the axle. The C.G. of the car is 105 cm above the rails.

Determine the limiting speed of the car, when it is rounding a curve of 300 m radius such that no wheel leaves the rails. Consider the centrifugal and gyroscopic effect completely.

Assume that no cant is provided for outer rail. **[16]**

P.T.O.

Q3) A 4 cylinder engine is arranged as shown in following fig. The reciprocating masses in planes 1 & 4 are each 100 kg and in planes 2 & 3 are each 173 kg. If the crank radius is 0.3 m, the length of connecting rod 1.2 m and speed 120 rpm.

Determine the magnitude of primary & secondary forces and couples. **[17]**


OR
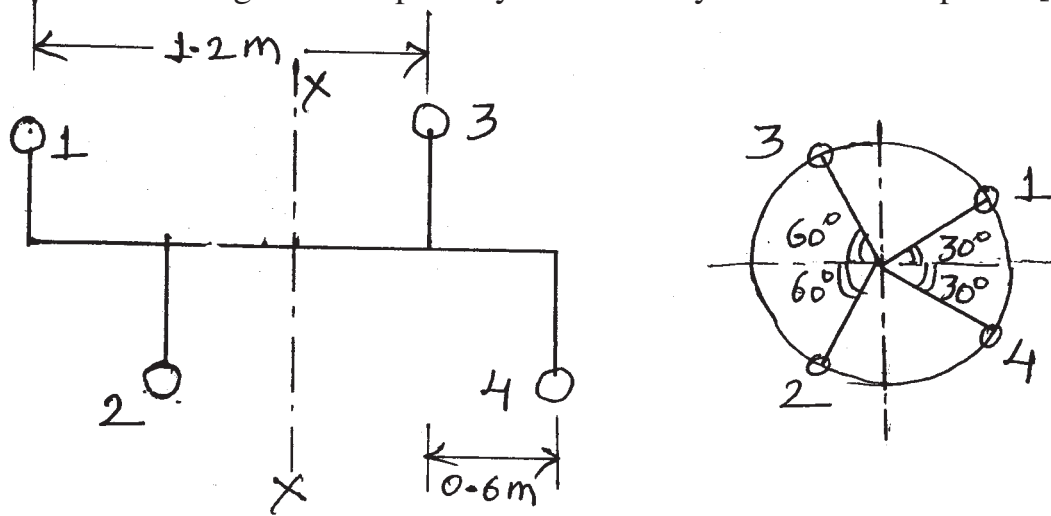
Q4) a) Explain the method of direct & reverse cranks to determine the unbalance forces in radial engines. **[6]**

b) Four masses are attached to the shaft at planes A, B, C & D at equal radii. The distance of planes B, C & D from A are 50 cm, 60 cm & 130 cm resp. The masses at A, B & C are 60 kg, 55 kg & 80 kg respectively. If the system is in complete balance, determine the mass at D and the position of masses B, C & D with respect to 'A'. **[11]**

Q5) a) Discuss the effects of damping on vibratory system. What is meant by underdamping, overdamping & critical damping? **[8]**

b) Assuming that the cylinder shown in following fig. rolls on the support without slippage, determine the equation of motion of the system, in terms of k, r, a & m. **[9]**
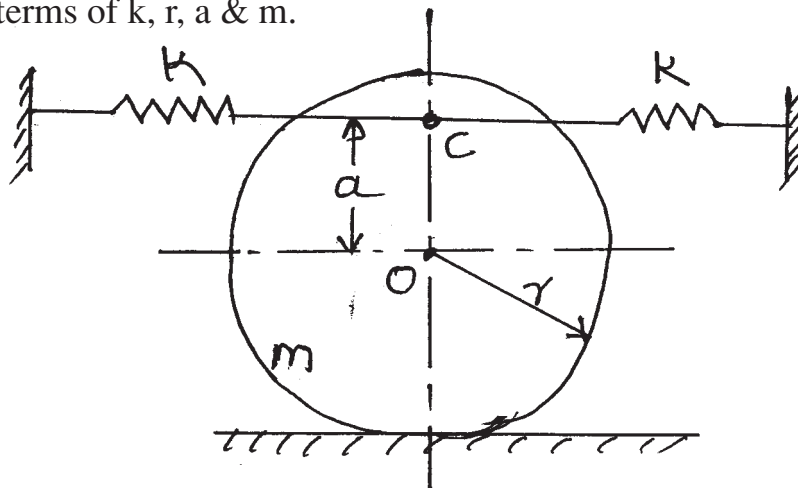
Q6) a) What is logarithmic decrement? Derive the relation for the same. **[8]**

b) A vibrating system consists of a mass of 50 kg, a spring of stiffness of 30 kN/m and a damper. The damping provided is only 20% of the critical value.

Determine :

i) The damping factor.

ii) The critical damping coefficient.

iii) The natural frequency of damped vibration.

iv) The logarithmic decrement.

v) The ratio of two consecutive amplitudes. **[9]**

SECTION - II

Q7) a) What are frequency response curves? Give the significance of these curves. **[6]**

b) Define vibration isolation & transmissibility. What are the typical materials used for vibration isolation. **[3]**

c) A vertical single stage compressor has a mass of 500 kg mounted on springs having stiffness of 1.96×10^5 N/m and a dashpot having damping factor of 0.2. The rotating parts are completely balanced and the equivalent reciprocating parts weigh 2 kg. The stroke of the compressor is 0.2 m. Find the dynamic amplitude of vertical motion and the phase difference between the motion and the excitation force, if the operating speed is 200 rpm? **[8]**

OR

Q8) a) Derive the expression for amplitude of a steady state forced vibration having an excitation force $F_0 . \sin(\omega t)$. **[9]**

b) A refrigerator weighing 30 kg is to be supported by 3 springs, each having stiffness of K (N/m). If the unit operates at 580 rpm, find k, if only 10% of the shaking force is to be transmitted to the supporting structure. Neglect damping. **[8]**

Q9) a) What is a 2 rotor system? Derive the relation to determine the natural frequency of a 2 rotor system? **[9]**

b) Two masses having mass 'm' are attached to a string having high tension as shown in following fig. Determine the natural frequencies for the arrangement. **[8]**
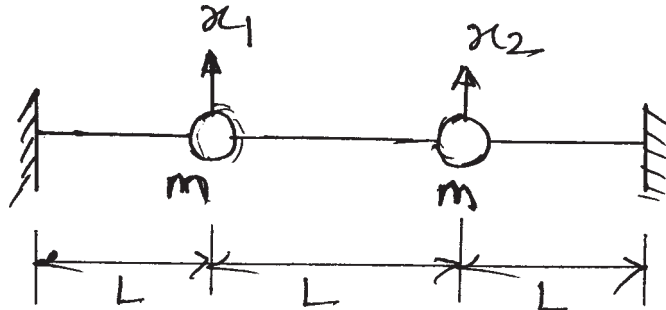
OR

Q10) A single cylinder engine drives a centrifugal pump with a flywheel connected between them. The rotating mass of engine, flywheel and the pump with the shaft is equivalent to 3 rotor system, as shown in following fig. The mass moment of inertia of the rotors A, B & C are 0.12 Kg.m², 0.3 Kg.m² and 0.09 Kg.m² respectively. The modulus of rigidity for shaft material is 84×10^9 N/m². Determine :

a) the natural frequency of torsional vibrations.

b) the amplitudes of single node & two nodes vibrations. **[17]**
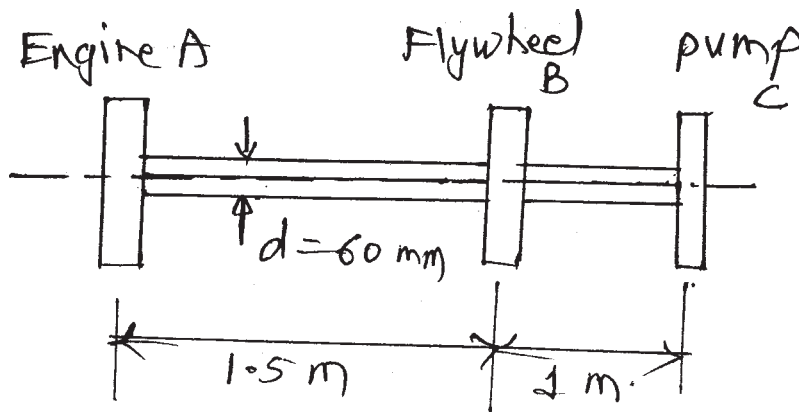
*Q11)*a) Derive a relation for shaft deflection in case of a vertical shaft having a single rotor & damping. **[8]**

b) What do you understand by time domain & frequency domain analysis? How are they useful in predicting vibration failures? **[8]**

OR

*Q12)*a) A vertical shaft 12.5 mm in diameter rotates in sleeve bearing and a disc of mass 15 kg is attached to the shaft at mid-span. The span of the shaft between bearings is 0.5 m. The mass centre of the disc is 0.5 mm from the axis of the shaft. Determine critical speed of rotation of shaft. What is range of speed in which bending stress in shaft will exceed 125 N/mm^2. Take E = 2 x 10^5 N/mm^2. **[8]**

b) Explain with neat diagrams : **[8]**

    i)   Stroboscope.

    ii) FFT spectrum analyser.

✦ ✦ ✦ ✦