

G 6983

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering

MARKETING AND SALES MANAGEMENT (M) (Elective-I)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Answer all questions.

Part A

Each question carries 4 marks.

1. List out the primary value activities.
2. Describe selling concept of Marketing.
3. What is the aim of strategic planning?
4. Explain the need of an organisation mission.
5. What are the challenges in New product development?
6. Describe the 'Growth stage' in product life cycle.
7. What are the social factors associated with consumer behaviour?
8. Discuss the relationship between 'self concept' and buying.
9. Define Sales management.
10. Give a brief classification of sales organisation.

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) What are the different marketing mix elements? Discuss.
Or
(b) Discuss in detail about the modern complex marketing system.
12. (a) "Without a strategy, the organisation is like a ship without a rudder". Discuss.
Or
(b) Describe the basic framework of strategic planning.

Turn over

13. (a) Explain the marketing strategies at the maturity and decline stages of a product.
- Or*
- (b) What is meant by 'Relationship Marketing'? Discuss the important factors responsible for the evolution of CRM.
14. (a) Define Consumer behaviour. What are the general characteristics of consumer behaviour?
- Or*
- (b) Differentiate between the Cultural and Personal factors that influence the buying process.
15. (a) Discuss in detail about the theories of selling process.
- Or*
- (b) Discuss the training methods suited for sales personnel.

[5 × 12 = 60 marks]

G 6980

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering

WELDING TECHNOLOGY (M) (Elective-I)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Part A

Answer all questions.

Each question carries 4 marks.

1. List the merits and limitations of welding as a fabrication process.
2. What are the different types of solders?
3. Illustrate the difference in rightward and leftward gas welding techniques.
4. How is acetylene prepared for gas welding?
5. What is the principle of Carbon Arc welding?
6. Differentiate ion and electron theories of arc column.
7. What is the principle of friction welding?
8. Write short notes on cold welding processes.
9. How are residual stresses relieved?
10. What is the significance of Heat affected zone in welding?

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) Sketch, explain and compare Seam Welding and Projection Welding processes.

Or

- (b) Write short notes on

- (i) Fluxes for soldering.
- (ii) Aluminium Brazing.
- (iii) Percussion welding.

Turn over

12. (a) Explain the types of flames obtained in gas welding and discuss the chemistry of Oxy-Acetylene flame.

Or

(b) Discuss the gas welding of stainless steel and Aluminium.

13. (a) Sketch Submerged Arc welding set up and explain process as well as applications.

Or

(b) Explain the functions and types of coatings used on Electrodes in SMAW.

14. (a) Sketch and explain plasma Arc Welding process.

Or

(b) Sketch and explain Electron Beam welding process.

15. (a) Explain any *three* Non-destructive testing methods of weldments.

Or

(b) Discuss the causes and remedies of any *four* commonly found defects in welded joints.

[5 × 12 = 60 marks]

G 6961

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch—Mechanical Engineering

MACHINE DESIGN AND DRAWING—I (M)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Answer any two from Part A and two from Part B suitably assume any missing data.

Part A

Each question carries 25 marks.

1. The cross-section of a flat key for a 40 mm dia shaft is 22×14 mm. The power transmitted by the shaft to the hub is 25 kW at 300 r.p.m. The key is made of steel ($\sigma_c = \sigma_t = 300 \text{ N/mm}^2$) and the factor of safety is 2.8. Determine the length of the key.
2. Design a Knuckle joint for transmitting a tensile load of 1000 kN using steel as material of the pin and rods with allowable
Stresses as Tensile stress = 80 N/mm^2 ;
Shear stress = 65 N/mm^2 ; compressive stress = 160 N/mm^2 .
3. A rigid coupling is used to transmit 20 kW at 720 r.p.m. There are 4 bolts and PCD of the bolts is 125 mm. The bolts are made of steel 45C8 ($\sigma_t = 380 \text{ N/mm}^2$) and the factor of safety 3. Determine the dia of the bolts.
4. A Double rivetted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume $\sigma_t = 80 \text{ N/mm}^2$, $\sigma_s = 60 \text{ N/mm}^2$; $\sigma_c = 120 \text{ N/mm}^2$. Find the efficiency of the joint state how the joint will fail.

(2 × 25 = 50 marks)

Part B

Each question carries 25 marks.

5. Design a closed coil helical compression spring for a service load ranging from 2.5 N to 3.0 N. The axial deflection of the spring for this load range is 6 mm. Assume a spring index of 5. Take $G = 8.4 \times 10^5 \text{ N/mm}^2$. $\sigma_s = 420 \text{ N/mm}^2$. Neglect the effect of stress concentration.
6. Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside dia of the hollow shaft being half of external diameter. Both the shafts have the same material and length.

Turn over

7. Design an aluminium piston for a single cylinder from stroke engine with the following specifications :-

Cylinder dia = 80 mm ;

Stroke = 100 mm

Maximum gas pressure = 5 N/mm²

Brake mean effective pressure = 0.65 N/mm²

Fuel consumption = 0.2 kg/kW/hr

Speed → 2000 r.p.m.

8. A 12.5 × 9.5 × 1 cm angle is joined to a frame by two parallel fillet welds along the edges to 15 cm long. The angle is subjected to a tensile load of 180 kN. Find the lengths of the weld if the permissible static load per cm weld length is 4.5 kN.

(2 × 25 = 50 marks)

G 6932

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering/Automobile Engineering

INDUSTRIAL ENGINEERING (M U)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Answer all questions.

Part A

Each question carries 4 marks.

1. What are the benefits of continuous production process?
2. List out any *four* functions of an Industrial process.
3. Describe cellular manufacturing systems.
4. Explain any *one* method for deciding replacement of an existing machinery.
5. What is a flow diagram?
6. Explain process chart symbols.
7. Describe the concept of Quality Circles.
8. Discuss the usefulness of Ergonomics in Industrial scenario.
9. Define Prime Cost.
10. What is meant by safety stock?

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) Define Productivity. Discuss the factors affecting productivity. Explain any *one* technique for productivity improvement.

Or

(b) What is value analysis? Discuss different phases and applications of value analysis.

12. (a) Discuss the factors influencing plant locations. What is meant by fixed position layout?

Or

(b) Describe depreciation by usage and depreciation by time. What are the methods of calculating depreciation?

Turn over

13. (a) What is meant by Micromotion study? Discuss the role of Therbligs in Micromotion study.

Or

(b) How Merit rating differs from Job evaluation? Explain the Non-qualitative methods of Merit rating.

14. (a) Define Industrial safety. Discuss the measures of Industrial safety in a process industry.

Or

(b) Discuss the role of Trade unions in the present Indian Industrial Scenario.

15. (a) Discuss the structure of Inventory control problems. Discuss the method of determining re-order level of a product.

Or

(b) What are the different types of control charts? Discuss the steps involved in the construction of \bar{X} charts.

(5 × 12 = 60 marks)

G 6923

(Pages : 2)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering

GAS DYNAMICS AND JET PROPULSION (M)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Use of approved gas tables, and charts are permitted.

Part A

Answer all the questions.

Each question carries 4 marks.

1. Define Knudsen Number. What is its significance ?
2. Explain why a rocket moving at supersonic speed, when passes over a stationary ground observer cannot be heard until it has passed over the observer ?
3. Define stagnation state. Derive an expression for the stagnation pressure ratio in terms of Mach Number.
4. Differentiate between an under expanded nuzzle and an over expanded nozzle.
5. Explain how a Rayleigh line is drawn on the h-s diagram.
6. Discuss how friction causes choking of the flow.
7. Explain how the strength of a shockwave is evaluated.
8. Explain how compression and expansion waves are formed in a compressible fluid.
9. What do you mean by Thrust Augmentation ?
10. Discuss the basic characteristics of Ramjet engine.

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) Derive an equation for sonic velocity.

Or

Turn over

- (b) An aircraft flies at an attitude of 15000 m ($P = 0.211 \times 10^5 \text{ N/m}^2$, $\rho = 0.1945 \text{ kg/m}^3$, $T = 216.65 \text{ K}$) with a velocity of 800 km/hr. Calculate (i) maximum possible temperature at the airplane skin ; (ii) pressure experienced by the body ; (iii) critical velocity of air relative to the plane and (iv) the maximum possible velocity of air relative to the air plane.

12. (a) Discuss the effect of back pressure on the performance of Converging-Diverging nozzle.

Or

- (b) The throat and exit areas of a converging-diverging nozzle in a wind tunnel are 4 cm^2 and 10 cm^2 respectively. The reservoir conditions are 10 bar and 95° C . Find out the Mach Number, Pressure and temperature of the air at the test section. Also find the mass flow rate.

13. (a) Show that the upper and lower branches of a Fannoline represents subsonic and supersonic flow. Also show that the maximum entropy condition is sonic.

Or

- (b) The ratio of stagnation temperature at the exit and entry of a combustion chamber is 3.75. If the pressure, temperature and flow Mach number at the exit are 2.5 bar, 1000° C and 0.9 respectively, determine (i) Mach Number, Pressure and temperature of the gas at entry ; (ii) Total heat supplied per kg of gas ; (iii) Maximum heat that can be supplied. Take $V = 1.4$ and $C_p = 1.2 \text{ kJ/kg-K}$.

14. (a) Derive the Prandtl-Meyer relation for a normal shock.

Or

- (b) The design pressure ratio of a steam turbine nozzle is 0.185. It operates at an off-design condition where the normal shock occurs. What are the values of design and off-design Mach Number at the nozzle exit? Take $V = 1.3$ for superheated steam.

15. (a) With the help of neat sketches explain the working of a turbojet engine. Discuss the effect of forward speed and attitude on the performance of turbojet engine.

Or

- (b) Define thrust on a rocket. Derive an expression for the net thrust. State five important properties desired in a liquid propellant.

(5 × 12 = 60 marks)

G 6940

(Pages : 3)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering/Automobile Engineering

REFRIGERATION AND AIR CONDITIONING (MU)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Use of R and A/C tables, charts and steam tables are permitted.

Answer all the questions.

Part A

Each question carries 4 marks.

1. Represent heat engine, heat pump and refrigerator on a common platform and compare.
2. What is meant by dense air refrigeration system with respect to air cycle refrigeration ?
3. Discuss dry and wet compression with the help of T-S diagram.
4. Discuss the effect of pressure drop in condenser and evaporator of a vapour compression system.
5. What are the advantages and disadvantages of steam set refrigeration system over other types of refrigeration systems.
6. Discuss the arrangement used for producing low temperature by adiabatic demagnetization of a paramagnetic salt.
7. Explain clearance volumetric efficiency of a reciprocating compressor.
8. Briefly explain the factors which affect the heat transfer capacity of an evaporator.
9. Explain the concept of "Effective Temperature" with reference to comfort air-conditioning.
10. What is the significance of sensible heat factor in air conditioning ?

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. (a) (i) A machine works on Carnot cycle between temperature limits of -10°C and 27°C . Find its COP when working as (1) a refrigerating machine ; (2) an heat pump ; and (3) an heat engine.

(5 marks)

Turn over

- (ii) A reversible heat engine operates between two reservoirs at temperatures 700°C and 50°C . The engine drives a reversible refrigerator which operates between reservoirs at 50°C and -25°C . The heat transfer to the engine is 2500 kJ and the network output of the combined system is 400 kJ . (1) Determine the net heat transfer to the reservoir at 50°C ; (2) Reconsider (i) if the efficiency of the heat engine and COP of the refrigerator are each 45 % of their maximum possible values.

(7 marks)

Or

- (b) A dense air based Bell-Coleman system working between 4-bar and 16-bar extracts 125 MJ/hr . The air enters the compressor at 5°C and enters the expander 23°C . The compressor is double acting and its stroke is 30 cm , γ_{air} is 1.4, mechanical efficiencies of compressor and expander are 0.85 and 0.87 respectively pair is 1.005 kJ/kg K , R_{air} is 287 J/kg-K . Assuming the unit runs at 300 r.p.m. , find

1 Power required to run the unit.

2 Bore of the compressor.

3 Refrigerating capacity in tonnes. Assume isentropic compression and expansion.

12. (a) The following data refers to a single stage vapour compression system. Refrigerant used R 134a, condensing temperature -35°C , evaporator temperature -10°C , for compressor, r.p.m. -2800 , clearance factor 0.03, swept volume -269.4 cm^3 , expansion index -1.12 , compression efficiency -0.8 , condensate sub cooling -5°C . Calculate (1) Capacity; (2) Power; (3) COP; (4) heat rejection to condenser and (4) relative COP of the system.

Or

- (b) Explain the complete multistage vapour compression system with flash meter cooling, flash gas removal and vapour inter cooler with the help of a neat sketch and p-h diagram.

(12 marks)

13. (a) Explain the desirable properties of an ideal refrigerant.

Or

- (b) Explain the working of a domestic electrolux refrigerator with the help of a neat sketch.

(12 marks)

14. (a) Explain the working of high-side and low-side float valves with the help of neat sketches.

Or

- (b) A single cylinder, single acting reciprocating compressor using R-12 as refrigerant has a bore 80 mm and stroke 60 mm . The compressor runs at 1450 r.p.m. . If the condensing temperature is 40°C , find the mass of refrigerant circulated per minute and the refrigerating capacity of the compressor when the evaporator is at (a) 10°C and (b) -10°C . Assume simple cycle and no clearance. Also determine the change in the results when the clearance factor is 5 % and the index of isentropic compression is 1.13.

(12 marks)

15. (a) (i) A mixture of dry air and water vapour is at a temperature of 22°C under a total pressure of 730 mm of Hg . The dew point temperature is 15°C . Find (1) partial pressure of water vapour; (2) relative humidity; (3) specific humidity; (4) enthalpy of air per kg of dry air; (5) specific volume of air per kg of dry air. Use only equation to solve the problem.

(6 marks)

- (ii) 120 m^3 of air per minute at 35°C DBT and 50 % RH is cooled to 20°C DBT by passing through a cooling coil. Determine the following: (1) RH of out coming air and its wbt; (2) capacity of cooling coil; (3) Amount of water vapour removed per hour the only equations to solve the problem.

(6 marks)

Or

- (b) 250 m^3 of air is supplied per minute from out door conditions of 38°C DBT and 25°C wbt to an air conditioned room. The air is dehumidified by a cooling coil having a by-pass factor 0.35 and dew point temperature 13°C and then by a chemical dehumidifier. Air leaves the chemical dehumidifier at 32°C DBT . Air then is passed over a cooling coil. Where surface temperature is 13°C and by-pass factor 0.25. Calculate the capacities of the two cooling coils and the humidifier.

(12 marks)

[5 × 12 = 60 marks]

G 6950

(Pages :3)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering

DYNAMICS OF MACHINERY (M)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Answer all the questions.

Part A

Each question carries 4 marks.

1. Explain primary cranks and secondary cranks.
2. What do you mean by primary and secondary imbalance in reciprocating engines ?
3. Derive the expression for logarithmic decrement.
4. Explain transmissibility.
5. Explain coordinate coupling.
6. Explain with a sketch vibration absorber.
7. Explain phase plane method.
8. Explain shock response spectrum.
9. Briefly explain Doppler effect.
10. Explain the process of recording and reproduction of sound.

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 210° respectively with B in the same sense. The planes containing B and C are 300 mm apart. Masses A, B, C and D can be assumed to be concentrated at radii of 360, 480, 240 and 300 mm respectively. The masses B, C and D are 15 kg, 25 kg and 20 kg respectively. Determine (i) the mass A and its angular position ; (ii) the positions of planes A and D.

Or

Turn over

12. (i) Describe any one type of a static balancing machine.
 (ii) What is field balancing of rotors? Explain the procedure.

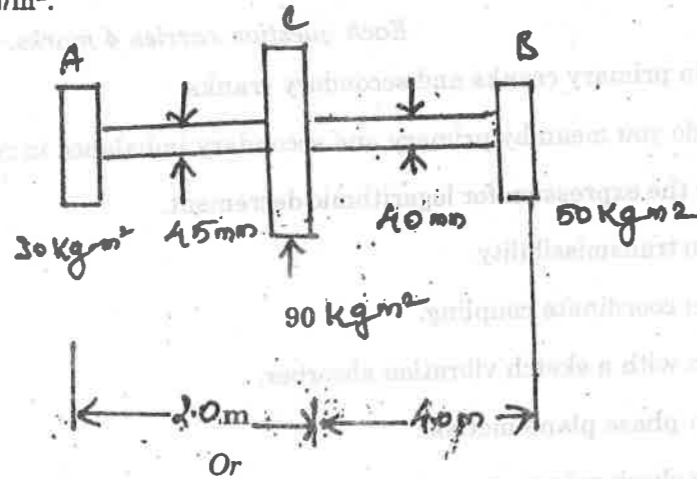
(6 + 6 = 12 marks)

13. Derive the expression for natural frequency of a single DOF system using (i) Equilibrium method;
 (ii) Energy method and (iii) Rayleigh's method.

Or

14. In a single degree freedom damped vibrating system, a suspended mass of 8 kg. makes 30 oscillations in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine (1) the stiffness of the spring; (2) the logarithmic decrement; (3) the damping factor; (4) the damping coefficient.

15. A torsional system is shown in Figure. Find the frequencies of torsional vibrations and positions of nodes. Take $G = 84 \times 10^9 \text{ N/m}^2$.



Or

16. A shaft 40 mm dia and 2.5 m long has a mass of 15 kg per metre length. It is simply supported at the ends and carries three masses 90 kg, 140 kg and 60 kg at 0.8 m, 1.5 m and 2 m respectively from the left support. Find the frequency of Transverse vibrations. Take $E = 200 \text{ GN/m}^2$.

17. The following data relate to a shaft held in long bearings :

Length of shaft = 1.2 m ; Diameter of shaft = 14 mm.

Mass of a rotor at midpoint = 16 kg.

Eccentricity of rotor mass from the rotor centre = 0.4 mm

$E = 200 \text{ GN/m}^2$.

Permissible stress in the shaft material = $70 \times 10^6 \text{ N/m}^2$.

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Assume the shaft to be massless.

Or

18. Explain the nature of non-linearity in the following systems :

(i) Simple pendulum.

(ii) A point mass in attached to the midpoint of a string.

19. (i) Explain the working of a sound level meter with a neat sketch.

(ii) Write short note on acoustical measurements.

(6 + 6 = 12 marks)

Or

20. (i) Write short note on acoustics of buildings.

(ii) Explain Acoustic Impedance filters.

(6 + 6 = 12 marks)

[5 × 12 = 60 marks]

G 6982

(Pages : 3)

Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, APRIL 2011

Seventh Semester

Branch : Mechanical Engineering

ADVANCED OPERATIONS RESEARCH (M)—(Elective I)

(Improvement/Supplementary)

Time : Three Hours

Maximum : 100 Marks

Part A

*Answer all questions.
Each question carries 4 marks.*

1. Give the mathematical statement of an optimization problem.
2. Explain sensitivity analysis based on graphical LP solution.
3. Explain 2 methods used for testing optimality of TP.
4. How will you tackle degeneracy during (i) initial stage ; (ii) during solution stage.
5. Describe Gomory's all integer cutting plane method in brief.
6. What are the applications of Goal programming ?
7. Give a list of situations, where dynamic programming can be applied effectively.
8. What are the difference between LP and DP ?
9. Explain steps involved in Monte Carlo simulation.
10. What is Simulation ? List the advantage of simulation technique.

(10 × 4 = 40 marks)

Part B

Each question carries 12 marks.

11. In a metal shop two articles are produced, "A" and "B". Article "A" takes 20 seconds to stamp, 30 seconds to form and 20 seconds to paint. The article "B" takes 40 seconds to stamp, 10 seconds to form and 16 seconds to paint. The profit margins on A & B 6 and 9 paise respectively. The time available per day on each process is 8 hours and 20 minutes.
 - (i) How many "A" and "B" type articles should be produced to maximize the profit ?
 - (ii) What is the maximum profit ?
 - (iii) Will the production policy change if profit margins were reversed ?
 - (iv) What will be the production policy and maximum gross profit with original objective function and capacities, if there is a maximum limit of 750 units of article "A".

Formulate the above problem and solve graphically.

Or

Turn over

12. Maximize $Z = 3x_1 - x_2$
 subject to $2x_1 + x_2 \geq 2$
 $x_1 + 3x_2 \leq 3$
 $x_2 \leq 4$
 $x_1, x_2 \geq 0$.

13. A product is produced by 4 factories A, B, C and D. The unit production costs in them are Rs. 20, 30, 10 and Rs. 50 respectively. Their production capacities are factory A – 50 units, B – 70 units, C – 30 units and D – 50 units. These factories supply the products to 4 stores, demand for which are 25, 35, 105 and 20 units respectively. Unit transportation cost from each factory to each store is given in the table below. Determine the extent of deliveries from each of the factory to each of the stores so that the total production and transportation cost is minimum.

	1	2	3	4
A	2	4	6	11
B	10	8	7	5
C	13	3	9	12
D	4	6	8	3

Or

14. Consider the problem of scheduling the weekly production of certain items for the next four weeks. The production cost of the item is Rs. 10 for the first two weeks, and Rs. 15 for the last 2 weeks. The weekly demands are 300, 700, 900 and 800, which must be met. The plant can produce a maximum of 700 units per week. The company can employ overtime during the second and third week. This increases weekly production by an additional 200 units, but production cost increases by Rs. 5. Excess production can be stored at a unit cost of Rs. 3 per week. How should be production be scheduled so as to minimize the total cost?
15. A small furnishing company manufactures tables and chairs. Each chair requires 4 man hours of labour while each table requires 5 man hours of labour. If only 80 man hours are available each week, and the owner of the company would neither hire additional labour nor utilize overtime, formulate the linear goal programming problem and solve it. Both the table and chair fetch a profit of Rs. 100 each. The owner has a target to earn a profit of Rs. 2,000 per week. He would like to supply 10 chairs if possible per week to a sister concern.

Or

16. Find the optimum integer solution to the following IPP :—

$$\begin{aligned} \text{Maximize } & Z = x_1 + 2x_2 \\ \text{subject to } & x_1 + x_2 \leq 7 \\ & 2x_1 = 11 \\ & 2x_2 \leq 7 \end{aligned}$$

x_1, x_2 are non-negative integers.

17. The following data are collected for a period of a couple of years regarding the frequency of advertising in a magazine, Television and posters by a company and the related sales of the product are listed below :

Frequency/week	Expected sales ($\times 1,000$ Rs.)		
	Magazine	Television	Posters
1	220	150	100
2	275	250	175
3	325	300	225
4	350	320	250

The cost of advertising in magazine, television and posters are Rs. 2,000, Rs. 1,000 and Rs. 500 respectively and there is a budget provision of Rs. 4,500/week for advertising. What is the optimum combination of media and advertising frequency to give the maximum expected sales?

Or

18. A wilderness hiker must pack three items, food, first-aid kits and clothes. The back pack has a capacity of 0.3 m^3 . Each unit of food takes 0.1 m^3 . A first aid kit occupies 0.025 m^3 and each piece of cloth takes 0.05 m^3 . The hiker assigns priority weights 3, 4 and 5 to food, first-aid and clothes. From experience, the hiker must take at least 1 unit of each item and no more than two first-aid kits. How many of each item the hiker should take?
19. Jobs arrive at a shop according to a Poisson distribution, with a mean of 6 jobs per day. The shop includes 5 machining centres to which the supervisor assigns the received jobs on a strict rotational basis. Determine one sample of the interval between the arrival of jobs at the first machining center.

Or

20. Four trucks loads of materials are delivered at a regular interval of 30 minutes. The trucks carry 2, 4, 2 and 4 tonnes respectively. Unloading is done by manual labourers. A team of two labourers can unload 500 kg. per hour. A penalty for delaying a truck beyond 30 minutes is charged at the rate of Rs. 50 per hour. The daily wage to each labourer is Rs. 60. Determine the number of teams for minimum total expenditure. The maximum number of teams to be engaged is six.

(5 \times 12 = 60 marks)